



City of Tacoma, WA

**TACOMA WATER
REQUEST FOR BIDS**

**BONNEY LAKE 950/1010 BOOSTER PUMP STATION
SPECIFICATION NO. TW22-0112F**

Tacoma Water

BID PROPOSAL, CONTRACT DOCUMENTS, AND SPECIFICATIONS FOR:

Bonney Lake 950/1010 Booster Pump Station

Project No. TAC 119.107

Winter 2022

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Signed: 04/15/2022



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Electrical
Signed: 04/15/2022



City of Tacoma
Tacoma Water

REQUEST FOR BIDS TW22-0112F
Bonney Lake 950/1010 Booster Pump Station

Submittal Deadline: 11:00 a.m., Pacific Time, Tuesday, May 10, 2022

Submittals must be received by the City's Procurement and Payables Division prior to 11:00 a.m. Pacific Time. For electronic submittals, the City of Tacoma will designate the time of receipt recorded by our email, bids@cityoftacoma.org, as the official time of receipt. This clock will be used as the official time of receipt of all parts of electronic bid submittals.

Submittal Delivery: Sealed submittals will be received as follows:

By Email:

bids@cityoftacoma.org

Maximum file size: 35 MB. Multiple emails may be sent for each submittal.

Bid Opening: Held virtually each Tuesday at 11AM. Attend [via this link](#) or call 1 (253) 215 8782.

Submittals in response to a RFB will be recorded as received. As soon as possible, after 1:00 PM, on the day of submittal deadline, preliminary results will be posted to www.TacomaPurchasing.org.

Solicitation Documents: An electronic copy of the complete solicitation documents may be viewed and obtained by accessing the City of Tacoma Purchasing website at www.TacomaPurchasing.org.

- [Register for the Bid Holders List](#) to receive notices of addenda, questions and answers and related updates.
- Click here to see a [list of vendors registered for this solicitation](#).

Pre-Proposal Meeting: A pre-proposal meeting will be held 9:00 a.m., PST, Wednesday, April 20, 2022 via [TEAMS](#).

Questions for this project will be accepted by the contact listed under additional information below no later than 3:00 p.m., PST, Tuesday, April 26, 2022. Answers will be posted to www.TacomaPurchasing.org on before May 3, 2022.

Project Scope: Fabrication of a packaged welded steel potable water booster pump station.

Estimate: \$900,000.00

Paid Sick Leave: The City of Tacoma requires all employers to provide paid sick leave as set forth in Title 18 of the Tacoma Municipal Code. For more information, visit [our Minimum Employment Standards Paid Sick Leave webpage](#).

Americans with Disabilities Act (ADA Information: The City of Tacoma, in accordance with Section 504 of the Rehabilitation Act (Section 504) and the Americans with Disabilities Act (ADA), commits to nondiscrimination on the basis of disability, in all of its programs and activities. Specification materials can be made available in an alternate format by emailing Gail Himes at ghimes@cityoftacoma.org, or by calling her collect at 253-591-5785.

Title VI Information:

"The City of Tacoma" in accordance with provisions of Title VI of the Civil Rights Act of 1964, (78 Stat. 252, 42 U.S.C. sections 2000d to 2000d-4) and the Regulations, hereby notifies all bidders that it will affirmatively ensure that in any contract entered into pursuant to this advertisement, disadvantaged business enterprises will be afforded full and fair opportunity to submit bids in response to this invitation and will not be discriminated against on the grounds of race, color, national origin in consideration of award.

Additional Information: Requests for information regarding the specifications may be obtained by contacting Tisha Rico, Senior Buyer by email to trico@cityoftacoma.org.

Protest Policy: City of Tacoma protest policy, located at www.tacomapurchasing.org, specifies procedures for protests submitted prior to and after submittal deadline.



Meeting sites are accessible to persons with disabilities. Reasonable accommodations for persons with disabilities can be arranged with 48 hours advance notice by calling 253-502-8468.

**CITY OF TACOMA
STANDARD TERMS AND CONDITIONS
GOVERNS BOTH GOODS AND SERVICES AS APPLICABLE**

In the event of an award by the City, these Terms and Conditions stated herein, Additional Contract Documents if issued, Solicitation if issued, Purchase Orders if issued by City, and Supplier's Submittal, if provided, shall constitute the Contract between City and Supplier for the acquisition of goods, including materials, supplies, and equipment or for the provision of services and deliverables.

Said documents represent the entire Contract between the parties and supersede any prior oral statements, discussions, or understandings between the parties, and/or subsequent Supplier invoices. No modification of the Contract shall be effective unless mutually agreed in writing.

The specific terms and conditions of any Solicitation (Specification, Request for Bids, Request for Proposals, Requests for Qualifications, Requests for Quotations, Request for Information, bid documents, request to enter into negotiations, or other form of solicitation issued by City including any general, special, or technical provisions associated with such Solicitations) are incorporated herein by reference and supersede these Terms and Conditions where there is conflict or inconsistency.

In the event Additional Contract Documents are negotiated and agreed to in writing between Supplier and City, the specific terms of such Additional Contract Documents are incorporated herein by reference and supersede all other terms and conditions where there is conflict or inconsistency.

These Terms and Conditions, Additional Contract Documents if issued, Solicitation if issued, City purchase order if issued, are controlling over Supplier's Submittal if a Submittal is provided. Submittals if provided are incorporated herein by reference.

1.01 SUPPLIER / CONTRACTOR

As used herein, "Supplier" or "Contractor" shall be the Supplier(s) entering a Contract with City, whether designated as a Supplier, Contractor, Vendor, Proposer, Bidder, Respondent, Seller, Merchant, Service Provider, or otherwise.

1.02 SUBMITTAL

Submittal means Bids, Proposals, Quotes, Qualifications or other information, content, records or documents submitted in response to a City Solicitation.

1.03 FORMS OF SUBMITTAL

Unless stated otherwise, all submittals must be in SAP Ariba and submitted exactly as specified or directed, and all required forms must be used.

1.04 COSTS TO PREPARE SUBMITTAL

The City is not liable for any costs incurred by Supplier for the preparation of materials or a Submittal provided in response to a solicitation, conducting presentations to the City, or any other activities related to responding to the City's Solicitation.

1.05 LICENSES/PERMITS

- A. Suppliers, if applicable, must have a Washington state business license at the time of Submittal and throughout the term of the Contract. Failure to include a Washington state business license may be grounds for rejection of the Submittal or cancellation of contract award. Information regarding Washington state business licenses may be obtained at <http://bls.dor.wa.gov>.
- B. Upon award, it is the responsibility of the Supplier to register with the City of Tacoma's Tax and License Division, 733 South Market Street, Room 21, Tacoma, WA 98402-3768, 253-591-5252, https://www.cityoftacoma.org/government/city_departments/finance/tax_and_license/. Supplier shall obtain a business license as is required by Tacoma Municipal Code Subtitle 6C.20.
- C. During the term of the Contract, Supplier, at its expense, shall obtain and keep in force any and all necessary licenses and permits.

1.06 PUBLIC DISCLOSURE: PROPRIETARY OR CONFIDENTIAL INFORMATION

- A. Supplier Submittals, all documents and records comprising the Contract, and all other documents and records provided to the City by Supplier are deemed public records subject to disclosure under the Washington State Public Records Act, Chapter 42.56 RCW (Public Records Act). Thus, City may be required, upon request, to disclose the Contract and documents or records related to it unless an exemption under the Public Records Act or other laws applies. In the event CITY receives a request for such disclosure, determines in its legal judgment that no applicable exemption to disclosure applies, and Supplier has complied with the requirements to mark records considered confidential or proprietary as such requirements are stated below, City agrees to provide Supplier 10 days written notice of impending release. Should legal action thereafter be initiated by Supplier to enjoin or otherwise prevent such release, all expense of any such litigation shall be borne by Supplier, including any damages, attorneys' fees or costs awarded by reason of having opposed disclosure. City shall not be liable for any release where notice was provided and Supplier took no action to oppose the release of information.
- B. If Supplier provides City with records or information that Supplier considers confidential or proprietary, Supplier must mark all applicable pages or sections of said record(s) as "Confidential" or "Proprietary." Further, in the case of records or information submitted in response to a Request for Proposals, an index must be provided indicating the affected pages or sections and locations of all such material identified Confidential or Proprietary. Information not included in the required index will not be reviewed for confidentiality or as proprietary before release. If Supplier fails to so mark or index Submittals and related records, then the City, upon request, may release said record(s) without the need to satisfy the requirements of subsection A above; and Supplier expressly waives its right to allege any kind of civil action or claim against the City pertaining to the release of said record(s).
- C. Submission of materials in response to City's Solicitation shall constitute assent by Supplier to the foregoing procedure and Supplier shall have no claim against the City on account of actions taken pursuant to such procedure.

1.07 SUSTAINABILITY

- A. The City has interest in measures used by its contractors to ensure sustainable operations with minimal adverse impact on the environment. The City seeks to do business with vendors that value community and environmental stewardship that help us meet our sustainable purchasing goals.
- B. The City encourages the use of environmentally preferable products or services that help to minimize the environmental and human health impacts of City operations. Suppliers are encouraged to incorporate environmentally preferable products or services into Submittals wherever possible. "Environmentally preferable" means products or services that have a lesser or reduced effect on human health and the environment when compared with competing products or services that serve the same purpose. This comparison may consider raw materials acquisition, production, manufacturing, packaging, distribution, reuse, operation, maintenance, or disposal of the product or service.
- C. Environmental Standards. The City seeks to ensure that all purchases comply with current environmental standards and product specifications. Where appropriate, third party independent certifiers such as Green Seal and USEPA Standards shall be a minimum specification for products to the City, unless specified otherwise herein.
- D. The City encourages the use of sustainability practices and desires any awarded Suppliers to assist in efforts to address such factors when feasible for:
 - 1. Pollutant releases
 - 2. Toxicity of materials used
 - 3. Waste generation
 - 4. Greenhouse gas emissions, including transportation of materials and services
 - 5. Recycle content
 - 6. Energy consumption
 - 7. Depletion of natural resources
 - 8. Potential impact on human health and the environment

1.08 ALTERATIONS NOT ALLOWED

Except as otherwise specifically provided in a Solicitation, Submittals that are incomplete or conditioned in any way, contain erasures, alternatives or items not called for, or not in conformity with law, may be rejected as being non-responsive. Any attempt to condition a Submittal by inserting exceptions to the Solicitation or any conditions, qualifications or additions that vary its terms may result in rejection of the Submittal. The City may reject any submittal containing a material deviation from the Solicitation.

1.09 CORRECTION OF AMBIGUITIES AND OBVIOUS ERRORS

- A. The City reserves the right to correct obvious errors in Supplier's Submittal. In this regard, if the unit price does not compute to the extended total price, the unit price shall govern.
- B. Supplier shall notify the City of Tacoma Procurement and Payables Division in writing of any ambiguity, conflict, discrepancy, omission or other error in a Solicitation no later than five business days prior to the submittal deadline.
 - 1. For solicitations conducted in SAP Ariba, Supplier shall notify the City of Tacoma Procurement and Payables Division on the message board of the event.
 - 2. For all other solicitations, Supplier shall notify the contract person listed in the Solicitation.
- C. The City will make necessary modifications by addendum.
- D. Supplier is responsible for identifying ambiguities, conflicts, discrepancies, omissions or other errors in the Solicitation prior to providing its Submittal or the ambiguity, conflict, discrepancy, omission, or other error is waived. Any Submittal that includes assumed clarifications and/or corrections without the required authentication of the same is subject to rejection.

1.10 WARRANTIES/GUARANTEE

- A. Suppliers warrant that all items, including services, as applicable:
 - 1. Are merchantable.
 - 2. Comply with the City's latest drawings and specifications.
 - 3. Are fit for the City's intended use.
 - 4. Will be performed according to the skill and care required by customarily accepted good practices and procedures followed by service providers rendering the same or similar type of service.
 - 5. Are new and unused unless otherwise stated.
 - 6. Comply with all applicable safety and health standards established for such products by the Occupational Safety and Health Administration (OSHA), Washington Industrial Safety and Health Act (WISHA) and/or Consumer Products Safety Act (CPSA), and all other applicable state and federal laws or agency regulations.
 - 7. Are properly packaged and contain appropriate instructions or warnings, including applicable MSDS sheets.

1.11 PATENTS, TRADEMARKS AND COPYRIGHTS

Suppliers warrant that equipment and/or materials furnished, including software, do not infringe on any patent, trademark or copyright, and agree to indemnify, defend and hold harmless, the City in the event of any infringement or claim thereof.

1.12 DELIVERY OF SUBMITTALS TO THE CITY'S PROCUREMENT AND PAYABLES DIVISION

- A. Submittal packages must be received by the City's Procurement and Payables Division in SAP Ariba (unless another form of delivery is stated), prior to the scheduled time and date stated in the Solicitation.
- B. Supplier is solely responsible for timely delivery of its Submittal.
- C. Submittals received after the time stated in the solicitation will not be accepted.
- D. For purposes of determining whether a Submittal has been timely received in SAP Ariba, the City's Procurement and Payables Division will rely on the submittal clock in SAP Ariba.

1.13 SUBMITTAL IS NON-COLLUSIVE

Supplier acknowledges that by its delivery of a Submittal to the City in response to a Solicitation, it represents that the prices in such Submittal are neither directly nor indirectly the result of any formal or informal agreement with another Supplier.

1.14 PARTNERSHIPS

The City will allow firms to partner in order to respond to a Solicitation. Multiple suppliers may team under a Prime Supplier's Submittal in order to provide responses to all sections in a single submission; however, each Supplier's participation must be clearly delineated by section. The Prime Supplier will be considered the responding vendor and the responsible party at contract award. All contract negotiations will be conducted only with the Prime Supplier. All contract payments will be made only to the Prime Supplier. Any agreements between the Prime Supplier and other companies will not be a part of the Contract between the City and the Prime Supplier. The City reserves the right to select more than one Prime Supplier.

1.15 WITHDRAWAL OF SUBMITTALS

- A. Prior to Submittal Deadline. Submittals may be withdrawn (including in SAP Ariba) prior to the scheduled submittal deadline.
- B. After Submittal Deadline. No Submittal can be withdrawn after having been opened before the actual award of the contract, unless the award is delayed more than 90 calendar days beyond the date of opening. If a delay of more than 90 calendar days does occur, Supplier must submit written notice to the City purchasing manager that Supplier is withdrawing its submittal.

1.16 ACCEPTANCE OF SUBMITTALS

- A. If the solicitation announcement so states, submittals, unless previously withdrawn, will be read aloud, irrespective of any irregularities or informalities in such submittal, at the time and place specified in the solicitation announcement.
- B. All submittals must remain open for acceptance by the City for a period of at least 90 calendar days from the submittal deadline.

1.17 RIGHT TO REJECT

The City of Tacoma reserves the right to reject any and all submittals, waive minor deviations or informalities, supplement, amend, reduce or otherwise modify the scope of work or cancel the solicitation, and if necessary, call for new submittals.

1.18 RESERVED RIGHTS

- A. By providing a submittal in response to a City solicitation, Supplier acknowledges and consents to the below City rights and conditions. With regard to this procurement process, the City reserves, holds without limitation, and may exercise, at its sole discretion, the following rights and conditions:
 - 1. To terminate the procurement process or decide not to award a contract as a result thereof by written notice to the Suppliers for any reason whatsoever with or without substitution of another solicitation.
 - 2. To waive any defect, technicality, or any other minor informality or irregularity in any submittal, or any other response from Suppliers.
 - 3. To issue addenda for any purpose including:
 - a. To make minor or major changes or alterations to the evaluation, selection and/or performance schedule(s) for any events associated with a procurement.
 - b. To supplement, amend, reduce, cancel, or otherwise modify a Solicitation, including but not limited to modifications to the description of services and/or products contained in the solicitation, by omitting services/products and/or including services/products.
 - 4. To request clarifications, additional information, and/or revised Submittals from one or more Suppliers.
 - 5. To conduct investigations with respect to the qualifications and experience of Supplier(s), including inspection of facilities and to request additional evidence to support any such information.

6. To eliminate any Supplier that submits an incomplete or inadequate response, or is non-responsive to the requirements of a Solicitation, or is otherwise deemed to be unqualified during any stage of the procurement process.
7. To select and interview a single finalist or multiple finalists to further the City's evaluation of Submittals provided in response to a Solicitation. The City may, in its sole and exclusive discretion as to what is in the City's best interest, elect not to conduct interviews of any or all Suppliers in connection with a solicitation process.
8. Except in the case of Requests for Bids, to negotiate any rate/fee offered by a Supplier. The City shall have the sole right to make the final rate/fee offer during contract negotiations. If the selected Supplier does not accept the City's final offer, the City may, in its sole discretion discontinue contract negotiations and commence negotiations with another Supplier, except as otherwise provided in Chapter 39.80, RCW.
9. To select and enter into a Contract with one or more Suppliers whose Submittal best satisfies the interests of the City and is most responsive, in the sole judgment of the City, to the requirements of a Solicitation.
10. To award by line item or group of line items.
11. To not award one or more items.
12. To issue additional or subsequent solicitations.
13. To seek partnerships between one or more Suppliers.
14. Request additional related products and services from the selected Supplier(s) as necessary throughout the term of the Contract.
15. Negotiate costs or fees in the event of new legislation or regulatory changes, or issuance of related compliance guidance, technology enhancements, and innovative solutions.
16. In the event the City receives questions concerning a Solicitation from one or more Suppliers prior to the deadline for response, the City reserves the right to provide such questions, and the City's responses, if any, to all Suppliers.
17. If an award is made and, prior to entering into a contract, subsequent information indicates that such award is not in the best interest of the City, the City may rescind the award without prior notice to Supplier and either award to another Supplier or reject all submittals or cancel this solicitation.
18. To cancel award of a contract at any time before execution of the Contract by both parties if cancellation is deemed to be in the City's best interest. In providing a submittal, Suppliers agree that the City is not liable for any costs or damages for the cancellation of an award. Supplier assumes the sole risk and responsibility for all expenses connected with the preparation of its submittal.
19. To add additional City departments or divisions to the Contract or develop a separate Contract with the Supplier subject to all terms, conditions and pricing of the original Contract
20. To take any other action affecting a Solicitation or a procurement process that is determined to be in the City's best interests.

1.19 SUBMITTAL CLARIFICATION

Suppliers may be asked to clarify their Submittal. This action shall not be construed as negotiations or any indication of intentions to award. If called upon, Supplier must respond to such requests within two business days or the timeframe set forth by the City in its request for clarification. Supplier's failure to respond to such a request may result in rejection of its Submittal.

1.20 EVALUATION OF SUBMITTALS

- A. The City of Tacoma reserves the right to award to the lowest and best responsible Supplier(s) delivering a Submittal in compliance with the Solicitation, provided such Submittals are reasonable and are in the best interest of the City to accept. The City may use a number of criteria for determining award, including evaluation factors set forth in Municipal Code Section 1.06.262. Suppliers who are inexperienced or who fail to properly perform other contracts may have their submittal rejected for such cause.
1. Evaluation Factors. In addition to the factors set forth in Municipal Code Section 1.06.262, the following may be used by the City in determining the lowest and best responsible Submittal:
 - a. Compliance with a Solicitation and with applicable City requirements, including by not limited to, the City's Ethics Code and its Small Business Enterprise and Local Employment and Apprenticeship programs.
 - b. Submittal prices, listed separately if requested, as well as a lump sum total (if the unit price does not compute to the extended total price, the unit price shall govern).
 - c. The total cost to the City, including all applicable taxes, may be the basis for contract award.
 - d. Time of delivery and/or completion of performance (delivery date(s) offered).
 - e. Warranty terms.
 - f. Quality of performance of previous contracts or services, including safety requirements and past compliance with the City's Ethics Code.
 - g. Previous and existing compliance with laws and ordinances relating to contracts or services.
 - h. Sufficiency of financial resources.
 - i. Quality, availability, and adaptability of the supplies or services to the particular use required.
 - j. Ability to provide future maintenance and service on a timely basis.
 - k. Location of nearest factory authorized warranty repair facility or parts dealership.
 - l. Ability, capacity, experience, stability, reputation, integrity, character, judgment, technical qualifications, and skill to perform the contract or provide the services required.
 2. Prompt Payment Discount. Payment discount periods of 20 calendar days or more, if offered in the submittal, will be considered in determining the apparent lowest responsible submittal. Discounts will be analyzed in context of their overall cumulative effect.
 - a. ePayable/Credit Card Acceptance. Submittals offering ePayable/Credit card acceptance may be compared against submittals offering a prompt payment discount to evaluate the overall cumulative effect of the discount against the advantage to the City of the ePayable/Credit card acceptance, and may be considered in determining the apparent lowest responsible submittal.
 3. All other elements or factors, whether or not specifically provided for in a Solicitation, which would affect the final cost to, and the benefits to be derived by, the City, may be considered in determining the award of a Contract. The final award decision will be based on the best interests of the City.

1.21 CONTRACT OBLIGATION

- A. The Submittal contents of the successful Supplier will become contractual obligations if a Contract ensues.
- B. In the event the City of Tacoma determines to award a Contract, the selected Supplier(s) may be requested to execute Additional Contract Documents.
- C. Supplier shall register with the City of Tacoma on the SAP Ariba Network and be enabled for transactions upon request by the City.
- D. Suppliers may propose amendments to City's Contract documents or to these Terms and Conditions, but the City retains the right to accept or reject proposed amendments.
- E. No costs chargeable for work under the proposed Contract may be incurred before mutual acceptance and execution as directed.

1.22 AWARD

The City reserves the right to award Contracts for any or all items to one or more Suppliers in the best interests of the City.

1.23 SUPPLIER'S REFUSAL TO ENTER INTO CONTRACT

Any Supplier who refuses to enter into a Contract after it has been awarded to the Supplier will be in breach of the agreement to enter the Contract, and Supplier's certified or cashier's check or bid bond, if any, shall be forfeited.

1.24 LEGAL HOLIDAYS

A. The City of Tacoma observes the following holidays, which shall apply to performance of all contracts:

New Year's Day	January 1
Martin Luther King's Birthday	3rd Monday in January
Washington's Birthday	3rd Monday in February
Memorial Day	Last Monday in May
Independence Day	July 4
Labor Day	1st Monday in September
Veteran's Day	November 11
Thanksgiving Day	4th Thursday of November
Day after Thanksgiving	4th Friday of November
Christmas Day	December 25

B. When any of these holidays occur on Saturday or Sunday, the preceding Friday or the following Monday, respectively, is a legal holiday for the City of Tacoma.

1.25 CONTRACT TERM

All services shall be satisfactorily completed and all deliverables provided by the termination date stated, and the Contract shall expire on said date unless mutually extended in writing by the parties.

1.26 EXTENSION OF CONTRACT

Contracts shall be subject to extension at City's sole discretion.

1.27 TERMINATION AND SUSPENSION

A. Termination for Convenience

1. Supplies. The City may terminate a Contract for supplies at any time upon prior written notice to Supplier. Upon the effective date of termination specified in such notice, and payment by the City, all conforming supplies, materials, or equipment previously furnished hereunder shall become its property.
2. Services. The City may terminate a Contract for services at any time, with or without cause, by giving 10 business days written notice to Supplier. In the event of termination, all finished and unfinished work prepared by Supplier pursuant to the Contract shall be provided to the City. In the event City terminates the Contract due to the City's own reasons and without cause due to Supplier's actions or omissions, the City shall pay Supplier the amount due for actual work and services necessarily performed under the Contract up to the effective date of termination, not to exceed the total compensation set forth in the Contract.

B. Termination for Cause. The City may terminate a Contract for either services or supplies in the event of any material breach of any of the terms and conditions of the Contract if the Supplier's breach continues in effect after written notice of breach and 30 days to cure such breach and fails to cure such breach.

C. Suspension. For either services or supplies, the City may suspend a Contract, at its sole discretion, upon three business days' written notice to Supplier. Such notice shall indicate the anticipated period of suspension. Any reimbursement for expenses incurred due to the suspension shall be limited to Supplier's actual expenses and shall be subject to verification. Supplier shall resume performance of services under the Contract without delay when the suspension period ends.

D. Termination or suspension of a Contract by City shall not constitute a waiver of any claims or remaining rights the City may have against Supplier relative to performance under a Contract.

1.28 DEFAULT/BREACH

In the event of material default or breach by Supplier on any of the conditions of a Contract, Supplier agrees that the City may, at its election, procure the goods or services from other sources, and may deduct from the unpaid balance due Supplier, or collect against the bond or security (if any), or may invoice and recover from Supplier all costs paid in excess of the price(s) set forth in the Contract.

1.29 SCOPE OF SERVICES/CONTRACT MODIFICATION

Supplier agrees to diligently and completely perform the services and provide the deliverables required by a Contract.

- A. Supplies. The City at any time by written change order or other form of written contract amendment may make reasonable changes in the place of delivery, installation, or inspection, the method of shipment or packing, identification and ancillary matters that Supplier may accommodate without substantial additional expense.
- B. Services. The City shall have the right to make changes within the general scope of services and/or deliverables upon execution in writing of a change order or other written form of contract amendment. If the changes will result in additional work effort by Supplier the City agrees to reasonably compensate Supplier for such additional effort up to the maximum amount specified in the Contract or as otherwise provided by Tacoma Municipal Code. Any new services accepted by the City may be added to the Contract and/or substituted for discontinued services. New services shall meet or exceed all requirements of original award.
- C. Expansion Clause. A Contract may be further expanded in writing to include other related services or products normally offered by Supplier, as long as the price of such additional services or products have a profit margin equal to or less than that in place at the time of original submittal. Such additions and prices will be established in writing. New items not meeting these criteria will not be added to the Contract. Supplier profit margins are not to increase as a result any such expansion.

1.30 FEDERAL, STATE, AND MUNICIPAL LAWS AND REGULATIONS

Supplier shall comply with all federal, state, municipal, and/or local laws and regulations in the performance of all terms and conditions of the Contract. Supplier shall be solely responsible for all violations of the law from any cause in connection with its performance of work under the Contract.

1.31 PREVAILING WAGES

- A. If federal, state, local, or any applicable law requires Supplier to pay prevailing wages in connection with a Contract, and Supplier is so notified by the City, then Supplier shall pay applicable prevailing wages.
- B. If applicable, a Schedule of Prevailing Wage Rates and/or the current prevailing wage determination made by the Secretary of Labor for the locality or localities where the Contract will be performed is attached and made of part of the Contract by this reference. If prevailing wages do apply to the Contract, Supplier and its subcontractors shall:
 - 1. Be bound by and perform all transactions regarding the Contract relating to prevailing wages and the usual fringe benefits in compliance with the provisions of Chapter 39.12 RCW, as amended, the Washington State Prevailing Wage Act and/or the Davis-Bacon Act (40 U.S.C. 3141- 3144, and 3146-3148) and the requirements of 29 C.F.R. pt. 5 as may be applicable, including the federal requirement to pay wages not less than once a week,
 - 2. Ensure that no worker, laborer or mechanic employed in the performance of any part of the Contract shall be paid less than the prevailing rate of wage specified on that Schedule and/or specified in a wage determination made by the Secretary of Labor (unless specifically preempted by federal law, the higher of the Washington state prevailing wage or federal Davis-Bacon rate of wage must be paid)and Additionally, in compliance with applicable federal law, contractors are required to pay wages not less than once a week.
 - 3. Immediately upon award of the Contract, contact the Department of Labor and Industries, Prevailing Wages section, Olympia, Washington and/or the federal Department of Labor, to obtain full information, forms and procedures relating to these matters. Per such procedures, a Statement of Intent to Pay Prevailing Wages and/or other or additional documentation required by applicable federal law, must be submitted by Contractor and its subcontractors to the City, in the manner requested by the City, prior to any payment by the City hereunder, and an Affidavit of Wages Paid and/or other or additional documentation required by federal law must be received or verified by the City prior to final Contract payment.

1.32 COPELAND ANTI-KICKBACK ACT

For contracts subject to Davis Bacon Act the following clauses will be incorporated into the Contract:

1. Contractor. The contractor shall comply with 18 U.S.C. § 874, 40 U.S.C. § 3145, and the requirements of 29 C.F.R. pt. 3 as may be applicable, which are incorporated by reference into this contract.
2. Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clause above and such other clauses as FEMA may by appropriate instructions require, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all of these contract clauses.
3. Breach. A breach of the contract clauses above may be grounds for termination of the contract, and for debarment as a contractor and subcontractor as provided in 29 C.F.R. § 5.12.

1.33 FEDERAL AID PROJECTS

The City of Tacoma, in accordance with Title VI of the Civil Rights Act of 1964, 78 Stat. 252, 42 U.S.C. 2000d to 2000d-4 and Title 49, Code of Federal Regulations, Department of Transportation, subtitle A, Office of the Secretary, part 21, nondiscrimination in federally assisted programs of the Department of Transportation issued pursuant to such Act, hereby notifies all bidders that it will affirmatively insure that in any contract entered into pursuant to this advertisement, disadvantaged business enterprises as defined at 49 CFR, part 26, will be afforded full opportunity to submit bids in response to this invitation and will not be discriminated against on the grounds of race, color, national origin, or sex in consideration for an award.

1.34 FEDERAL FINANCIAL ASSISTANCE

If federal funds, including FEMA financial assistance to the City of Tacoma, will be used to fund, pay or reimburse all or a portion of the Contract, Contractor will comply with all applicable Federal law, regulations, executive orders, FEMA policies, procedures, and directives and the following clauses will be incorporated into the Contract:

- A. **EQUAL EMPLOYMENT OPPORTUNITY.** During the performance of this Contract, Contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, sexual orientation, gender identity, or national origin. The contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, color, religion, sex, sexual orientation, gender identity, or national origin. Such action shall include, but not be limited to the following:
1. Employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided setting forth the provisions of this nondiscrimination clause.
 2. The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor; state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, or national origin.
 3. The Contractor will not discharge or in any other manner discriminate against any employee or applicant for employment because such employee or applicant has inquired about, discussed, or disclosed the compensation of the employee or applicant or another employee or applicant. This provision shall not apply to instances in which an employee who has access to the compensation information of other employees or applicants as a part of such employee's essential job functions discloses the compensation of such other employees or applicants to individuals who do not otherwise have access to such information, unless such disclosure is in response to a formal complaint or charge, in furtherance of an investigation, proceeding, hearing, or action, including an investigation conducted by the employer, or is consistent with the Contractor's legal duty to furnish information.
 4. The Contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice to be provided advising the said labor union or workers' representatives of the contractor's commitments under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

5. The Contractor will comply with all provisions of Executive Order 11246 of September 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor.
6. The Contractor will comply with all provisions of Executive Order 11246 of September 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor.
7. In the event of the Contractor's noncompliance with the nondiscrimination clauses of this Contract or with any of the said rules, regulations, or orders, this Contract may be canceled, terminated, or suspended in whole or in part and the contractor may be declared ineligible for further Government contracts or federally assisted construction contracts in accordance with procedures authorized in Executive Order 11246 of September 24, 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order 11246 of September 24, 1965, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.
8. The Contractor will include the portion of the sentence immediately preceding paragraph (1) and the provisions of paragraphs (1) through (8) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to section 204 of Executive Order 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. The Contractor will take such action with respect to any subcontract or purchase order as the administering agency may direct as a means of enforcing such provisions, including sanctions for noncompliance:

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

B. CONTRACT WORK HOURS AND SAFETY STANDARDS ACT

1. Overtime requirements. No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.
2. Violation; liability for unpaid wages; liquidated damages. In the event of any violation of the clause set forth in paragraph (B)(1) of this section the contractor and any subcontractor responsible therefor shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (B)(1) of this section, in the sum of \$27 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (b)(1) of this section.
3. Withholding for unpaid wages and liquidated damages. The City shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (B)(2) of this section.
4. Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraph (B)(1) through (4) of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs (B)(1) through (4) of this section.

C. CLEAN AIR ACT

1. Contractor agrees to comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act, as amended, 42 U.S.C. § 7401 et seq.
2. Contractor agrees to report each violation to the City and understands and agrees that the City will, in turn, report each violation as required to assure notification to the Federal Emergency Management Agency, and the appropriate Environmental Protection Agency Regional Office.
3. Contractor agrees to include these requirements in each subcontract exceeding \$150,000 financed in whole or in part with Federal assistance provided by FEMA.

D. FEDERAL WATER POLLUTION CONTROL ACT

1. Contractor agrees to comply with all applicable standards, orders, or regulations issued pursuant to the Federal Water Pollution Control Act, as amended, 33 U.S.C. 1251 et seq.
2. Contractor agrees to report each violation to the City and understands and agrees that the City will, in turn, report each violation as required to assure notification to the Federal Emergency Management Agency, and the appropriate Environmental Protection Agency Regional Office.
3. Contractor agrees to include these requirements in each subcontract exceeding \$150,000 financed in whole or in part with Federal assistance provided by FEMA.

E. DEBARMENT AND SUSPENSION

1. This Contract is a covered transaction for purposes of 2 C.F.R. pt. 180 and 2 C.F.R. pt. 3000. As such, the contractor is required to verify that none of the contractor's principals (defined at 2 C.F.R. § 180.995) or its affiliates (defined at 2 C.F.R. § 180.905) are excluded (defined at 2 C.F.R. § 180.940) or disqualified (defined at 2 C.F.R. § 180.935).
2. Contractor must comply with 2 C.F.R. pt. 180, subpart C and 2 C.F.R. pt. 3000, subpart C, and must include a requirement to comply with these regulations in any lower tier covered transaction it enters into.
3. This certification is a material representation of fact relied upon by the City. If it is later determined that the contractor did not comply with 2 C.F.R. pt. 180, subpart C and 2 C.F.R. pt. 3000, subpart C, in addition to remedies available to (insert name of recipient/subrecipient/applicant), the Federal Government may pursue available remedies, including but not limited to suspension and/or debarment.
4. Contractor agrees to comply with the requirements of 2 C.F.R. pt. 180, subpart C and 2 C.F.R. pt. 3000, subpart C while this offer is valid and throughout the period of any contract that may arise from this offer. The bidder or proposer further agrees to include a provision requiring such compliance in its lower tier covered transactions.

F. BYRD ANTI-LOBBYING AMENDMENT

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

2. If applicable, Contractor must sign and submit to the City the following certification:

APPENDIX A, 44 C.F.R. PART 18 – CERTIFICATION REGARDING LOBBYING
Certification for Contracts, Grants, Loans, and Cooperative Agreements

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

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

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

The Contractor, _____, certifies or affirms the truthfulness and accuracy of each statement of its certification and disclosure, if any. In addition, the Contractor understands and agrees that the provisions of 31 U.S.C. Chap.38, Administrative Remedies for False Claims and Statements, apply to this certification and disclosure, if any.

Signature of Contractor's Authorized Official

Name and Title of Contractor's Authorized Official

Date

G. PROCUREMENT OF RECOVERED MATERIALS

1. In the performance of this contract, the Contractor shall make maximum use of products containing recovered materials that are EPA-designated items unless the product cannot be acquired:
 - a. Competitively within a timeframe providing for compliance with the contract performance schedule;
 - b. Meeting contract performance requirements; or
 - c. At a reasonable price.
2. Information about this requirement, along with the list of EPA- designated items, is available at EPA's Comprehensive Procurement Guidelines web site, <https://www.epa.gov/smm/comprehensive-procurement-guideline-cpg-program>.
3. Contractor also agrees to comply with all other applicable requirements of Section 6002 of the Solid Waste Disposal Act.

1.35 CONTRACT PRICING

- A. Submitted prices shall include costs of submittal preparation, servicing of the account, all contractual requirements during contract period such as transportation, permits, insurance costs, bonds, labor, wages, materials, tools, components, equipment, and appurtenances necessary to complete the work, which shall conform to the best practice known to the trade in design, quality, material, and workmanship.
- B. Surcharges of any type will not be paid.
- C. If applicable, related additional products and corresponding services of benefit to the City not specifically required in a solicitation, but which Supplier offers to provide, may be included with the submittal. Supplier may request to add new products if the City approves them and Supplier can demonstrate the pricing is from the same pricing structure/profit margin.
- D. Unless specifically stated otherwise, only firm prices will be accepted and all prices shall remain firm during the term of a Contract.
- E. Price increases may at City's discretion be passed along during a contract period if the increase is mandated by statute, or the result of a tariff.
- F. By submitting prices, Supplier warrants prices equal to or better than the equivalent prices, terms, and benefits offered by Supplier to any other government unit or commercial customer.
- G. Should Supplier, during the term of a Contract, enter into any other contract, agreement or arrangement that provides lower prices, more favorable terms or greater benefits to any other government unit or commercial customer, the Contract with the City shall thereupon be deemed amended to provide the same price or prices, terms and benefits to the City. This provision applies to comparable products and purchase volumes by the City that are not less than the purchase volumes of the government unit or commercial customer that has received the lower prices, greater benefits, or more favorable terms.
- H. If at any time during the term of the Contract, Supplier reduces prices to other buyers purchasing approximately the same quantities stated on the Contract, Supplier will immediately notify the City purchasing manager of such fact, and the price(s) for future orders under the Contract shall be reduced accordingly.
- I. The City is entitled to any promotional pricing during the Contract period.
- J. Price decreases shall be immediately passed on to the City.
- K. The City reserves the right to increase or decrease the quantities of any item awarded pursuant to the Contract and pay according to the unit prices quoted in the submittal with no adjustments for anticipated profit.

1.36 APPROVED EQUALS WHEN ALTERNATES ARE ALLOWED

- A. Unless an item is indicated as "no substitute," special brands, when named, are intended to describe the standard of quality, performance, or use desired. Equal items will be considered by the City, provided that Supplier specifies the brand and model, and provides all descriptive literature, independent test results, specification sheets, schematic drawings, photographs, product samples, local servicing, parts availability, etc., to enable the City to evaluate the proposed equal. Performance testing in the field may be required.
- B. The decision of the City as to what items are equal shall be final and conclusive. If the City elects to purchase a brand represented by Supplier to be an "equal," the City's acceptance of the item is conditioned on the City's inspection and testing after receipt. If, in the sole judgment of the City, the item is determined not to be an equal, the item shall be returned at Supplier's expense.
- C. When a brand name or level of quality is not stated in Supplier's submittal, it is understood Supplier's submittal shall exactly confirm with those required in the Contract. If more than one brand name is stated in a Solicitation, Supplier(s) must indicate the brand and model/part number to be supplied.

1.37 RISK OF LOSS, SHIPPING AND DELIVERY

- A. Shipping. Prices must be quoted FOB destination (the place of destination as defined in RCW 62A.2-319, as that statute may hereafter be amended), with freight prepaid and allowed (shipping costs included in unit prices), and risk of loss remaining with Supplier until delivery is tendered.
- B. Delivery. Delivery will be to the designated addresses set forth in a Solicitation or as otherwise stated in the Contract. Deliveries shall be between 9:00 a.m. and 3:30 p.m., Monday through Friday only, except Legal Holidays. Failure to make timely delivery shall be cause for termination of the contract or order and return of all or part of the items at Supplier's expense except in the case of force majeure.

1.38 DELIVERY OF PRODUCTS AND PROVISION OF SERVICES – IDLING PROHIBITED

- A. The City of Tacoma has a commitment to reduction of unnecessary fuel emissions and improving air quality by reducing unnecessary air pollution from idling vehicles. Limiting car and truck idling supports cleaner air, healthier work environments, the efficient use of city resources, the public's enjoyment of City properties and programs, conservation of natural resources, and good stewardship practices.
- B. Vehicles and/or diesel fuel trucks shall not idle at the time and location of the delivery to the City of Tacoma for more than three minutes. The City requires contractors to utilize practices that reduce fuel consumption and emission discharge, including turning off trucks and vehicles during delivery of products to the City. Exceptions to this requirement include when associated power is necessary to make a delivery or provide the service, when the engine is used to provide power to another device, and when a running engine is required for proper warm-up and cool-down of the engine.

1.39 PACKING SLIPS AND INVOICES

- A. Each invoice shall show City of Tacoma purchase order number, release number if applicable, quantity, unit of measure, item description, unit price and extended price for each line if applicable, services and deliverables provided if applicable. Line totals shall be summed to give a grand total to which sales tax shall be added, if applicable.
 - 1. For transactions conducted in SAP Ariba, invoices shall be submitted through Ariba.
 - 2. For invoices paid by ACH or by check, unless stated otherwise, invoices shall be electronically submitted by email with corresponding PO number listed in the subject line to accountspayable@cityoftacoma.org.
 - 3. For invoices paid by credit card, invoices shall also display the last name of the cardholder and last four digits (only) of the card number (e.g., Jones/6311). Unless stated otherwise, invoices shall be electronically submitted by email with corresponding PO number listed in the subject line to (do not combine different POs into one invoice or charge) to pcardadmin@cityoftacoma.org.

- B. Any terms, provisions or language in Supplier's invoice(s) that conflict with the terms of the Contract are superseded and shall not apply to the Contract unless expressly accepted in writing by the City.
- C. Packing slips and shipping notices shall be sent to the specific City Division or Department receiving the item(s) at the address stated in City's Solicitation or as otherwise stated in the Contract and include complete description of items, contents of items if crated or cased, quantity, shipping point, carrier, bill of lading number and City of Tacoma purchase order.
- D. Supplier shall package orders, preferably in environmental friendly packaging such as reduced packaging and recyclable packing materials.

1.40 COOPERATIVE PURCHASING

The Washington State Interlocal Cooperation Act RCW 39.34 provides that other governmental agencies may purchase goods and services based on the Contract with the City in accordance with the terms and prices of the Contract if all parties are agreeable. Each public agency shall formulate a separate contract with Supplier, incorporating the terms and conditions of the Contract with the City of Tacoma. The City shall incur no liability in connection with such contracts or purchases by other public agencies thereunder. It will be Supplier's responsibility to inform such public agencies of the Contract with the City. Supplier shall invoice such public agencies as separate entities.

1.41 TAXES

- A. Unless otherwise stated, applicable federal, state, City, and local taxes shall be included in the submittal and in contract as indicated below. As used herein, the term "taxes" shall include any and all taxes, assessments, fees, charges, interest, penalties, and/or fines imposed by applicable laws and regulations in connection with the procurement of goods and/or services hereunder.
 - 1. Federal Excise Tax. The City of Tacoma is exempt from federal excise tax. The City will furnish a Federal Excise Tax Exemption certificate, if required. If Supplier fails to include any applicable tax in its submittal, then Supplier shall be solely responsible for the payment of said tax.
 - 2. State and Local Sales Tax. The City of Tacoma is subject to Washington state sales tax. It is Supplier's obligation to state the correct sales tax percentage and include the applicable Washington state, city and local sales tax as a separate line item(s) in the submittal.
 - 3. City of Tacoma Business and Occupation Tax. It is Supplier's obligation to include City of Tacoma Business and Occupation tax in the unit and/or lump sum prices submitted; it shall not be shown separately on the submittal. Per Sub-Title 6A of the City of Tacoma Municipal Code, transactions with the City of Tacoma may be subject to the City's Business and Occupation Tax.
- B. Any or All Other Taxes. Any or all other taxes are the responsibility of Supplier unless otherwise required by law. Except for state sales tax, Supplier acknowledges that it is responsible for the payment of all taxes applicable to the Contract and Supplier agrees to comply with all applicable laws regarding the reporting of income, maintenance of records, and all other requirements and obligations imposed pursuant to applicable law.
- C. If the City is assessed, made liable, or responsible in any manner for taxes contrary to the provisions of the Contract, Supplier agrees to hold the City harmless from such costs, including attorney's fees. In the event Supplier fails to pay any taxes, assessments, penalties, or fees imposed by any governmental body, including a court of law, other than those taxes the City is required to pay, then Supplier authorizes the City to deduct and withhold or pay over to the appropriate governmental body those unpaid amounts upon demand by the governmental body. It is agreed that this provision shall apply to taxes and fees imposed by City ordinance. Any such payments shall be deducted from Supplier's total compensation.

1.42 COMPENSATION

- A. The City shall compensate Supplier in accordance with the Contract. Said compensation shall be the total compensation for Supplier's performance hereunder including, but not limited to, all work, services, deliverables, materials, supplies, equipment, subcontractor's fees and all reimbursable travel and miscellaneous or incidental expenses to be incurred by Supplier. Unless stated otherwise the total stated compensation may not be changed without a written change order or other form of contract amendment.
- B. Payment(s) made in accordance with the Contract shall fully compensate Supplier for all risk, loss, damages or expense of whatever nature, and acceptance of payment shall constitute a waiver of all claims submitted by Supplier.

1.43 PAYMENT TERMS

- A. Payment shall be made through the City's ordinary payment process, and shall be considered timely if made within 30 days of receipt of a properly completed invoice. All payments shall be subject to adjustment for any amounts, upon audit or otherwise, determined to have been improperly invoiced. The City may withhold payment to Supplier for any services or deliverables not performed as required hereunder until such time as Supplier modifies such services or deliverables to the satisfaction of the City.
- B. Invoices will not be processed for payment, nor will the period of cash discount commence, until all invoiced items are received and satisfactory performance of the Contract has been attained. Upon CITY'S request, Supplier shall submit necessary and appropriate documentation, as determined by the CITY, for all invoiced services and deliverables. If an adjustment in payment is necessary due to damage or dispute, the cash discount period shall commence on the date final approval for payment is authorized.

1.44 PAYMENT METHOD – EPAYABLES – CREDIT CARD ACCEPTANCE – EFT/ACH ACCEPTANCE

- A. Payment methods include:
 - 1. EPayables (Payment Plus). This is payment made via a virtual, single use VISA card number provided by the City's commercial card provider. Suppliers accepting this option will receive "due immediately" payment terms. Two options for acceptance are available to suppliers. Both are accompanied by an emailed advice containing complete payment details:
 - a. Straight-through processing (buyer initiated). Immediate, exact payments directly deposited to supplier accounts by the City's provider bank; the supplier does not need to know card account details.
 - b. Supplier retrieves card account through the secure, on-line portal provided via email notifications sent by the City's commercial card provider.
 - 2. Credit card. Tacoma's VISA procurement card program is supported by standard bank credit suppliers and requires that merchants abide by the VISA merchant operating rules. It provides "due immediately" payment terms.
 - a. Suppliers must be PCI-DSS compliant (secure credit card data management) and federal FACTA (sensitive card data display) compliant.
 - b. Suppliers must be set up by their card processing equipment provider (merchant acquirer) as a minimum of a Level II merchant with the ability to pass along tax, shipping and merchant references information.
 - 3. Electronic Funds Transfer (EFT) by Automated Clearing House (ACH). Standard terms are net 30 for this payment method.
 - 4. Check or other cash equivalent. Standard terms are net 30 for this payment method.
- B. The City's preferred method of payment is by ePayables (Payment Plus) followed by credit card (aka procurement card). Suppliers may be required to have the capability of accepting the City's ePayables or credit card methods of payment. **The City of Tacoma will not accept price changes or pay additional fees when ePayables (Payment Plus) or credit card is used.**
- C. The City, in its sole discretion, will determine the method of payment for goods and/or services as part of the Contract.

1.45 NOTICES

Unless otherwise specified, except for routine operational communications, which may be delivered personally or transmitted by electronic mail, all notices required by the Contract shall be in writing and shall be deemed to have been duly given if delivered personally or mailed first-class mail, postage prepaid, to Supplier's registered agent and to the applicable City department representative.

1.46 INDEPENDENT CONTRACTOR STATUS

- A. Supplier is considered an independent contractor who shall at all times perform his/her duties and responsibilities and carry out all services as an independent contractor and shall never represent or construe his/her status to be that of an agent or employee of the City, nor shall Supplier be eligible for any employee benefits. No payroll or employment taxes or contributions of any kind shall be withheld or paid by the City with respect to payments to Supplier. Supplier shall be solely responsible for all said payroll or employment taxes and/or contributions including, but not limited to, FICA, FUTA, federal income tax, state personal income tax, state disability insurance tax and state unemployment insurance tax. If the City is assessed, made liable or responsible in any manner for such taxes or contributions, Supplier agrees to indemnify and hold the City harmless from all costs incurred, including attorney fees.
- B. Unless otherwise specified in writing, Supplier shall provide at its sole expense all materials, working space, and other necessities and instruments to perform its duties under the Contract. Supplier, at its sole expense, shall obtain and keep in force any and all applicable licenses, permits and tax certificates necessary to perform the Contract.

1.47 NONDISCRIMINATION

Supplier agrees to take all steps necessary to comply with all federal, state, and City laws and policies regarding non-discrimination and equal employment opportunities. Supplier shall not discriminate in any employment action because of race, religion, color, national origin or ancestry, sex, gender identity, sexual orientation, age, marital status, familial status, or the presence of any sensory, mental, or physical handicap. In the event of non-compliance by Supplier with any of the non-discrimination provisions of the Contract, the City shall be deemed to have cause to terminate the Contract, in whole or in part.

1.48 REPORTS, RIGHT TO AUDIT, PERSONNEL

- A. Reports. Supplier shall, at such times and in such form as the City may reasonably require, furnish the City with periodic status reports pertaining to the services undertaken or goods provided pursuant to the Contract.
- B. Right to Audit. Upon City's request, Supplier shall make available to City all accounts, records and documents related to the scope of work for City's inspection, auditing, or evaluation during normal business hours as reasonably needed by City to assess performance, compliance and/or quality assurance under the Contract or in satisfaction of City's public disclosure obligations as applicable.
- C. Personnel. If before, during, or after the execution of a Contract, Supplier has represented or represents to the City that certain personnel would or will be responsible for performing services pursuant to the Contract, then Supplier is obligated to ensure that said personnel perform said Contract services to the maximum extent permitted by law. Substantial organizational or personnel changes within Supplier's firm are expected to be communicated to City immediately. Failure to do so could result in termination of the Contract. This provision shall only be waived by written authorization by the City, and on a case-by-case basis.

1.49 INSURANCE

- A. During the course and performance of a Contract, Supplier will provide proof and maintain the insurance coverage in the amounts and in the manner specified in the City of Tacoma Insurance Requirements as is applicable to the services, products, and deliverables provided under the Contract. The City of Tacoma Insurance Requirements document, if issued, is fully incorporated into the Contract by reference.
- B. Failure by City to identify a deficiency in the insurance documentation provided by Contractor or failure of City to demand verification of coverage or compliance by Contractor with these insurance requirements shall not be construed as a waiver of Contractor's obligation to maintain such insurance.

1.50 INDEMNIFICATION – HOLD HARMLESS

- A. Supplier agrees to indemnify, defend, and hold harmless the City of Tacoma, its officers, agents and employees, from and against any and all liability which may accrue to or be sustained by the City of Tacoma for any claim, suit or legal action made or brought against the City for the death of or injury to persons (including Supplier's or subcontractor's employees), or damage to property involving Supplier or subcontractor(s) and their employees or agents, or for any other cause arising out of and in connection with or incident to the performance of the Contract, except for injuries or damages caused by the sole negligence of the City. In this regard, Supplier recognizes it is waiving immunity under Industrial Insurance Law, Title 51 RCW. This indemnification includes attorney's fees and the cost of establishing the right to indemnification hereunder in favor of the City of Tacoma. By Supplier's acceptance of this order, he/she agrees that this subsection has been mutually negotiated.
- B. These indemnifications shall survive the termination of a Contract.

1.51 CONFLICT OF INTEREST

No officer, employee, or agent of the City, nor any member of the immediate family of any such officer, employee or agent as defined by City ordinance, shall have any personal financial interest, direct or indirect, in a Contract, either in fact or in appearance. Supplier shall comply with all federal, state, and City conflict of interest laws, statutes, and regulations. Supplier represents that Supplier presently has no interest and shall not acquire any interest, direct or indirect, in the program to which the Contract pertains that would conflict in any manner or degree with the performance of Supplier's services and obligations hereunder. Supplier further covenants that, in performance of a Contract, no person having any such interest shall be employed. Supplier also agrees that its violation of the City's Code of Ethics contained in Chapter 1.46 of the Tacoma Municipal Code shall constitute a breach of Contract subjecting the Contract to termination.

1.52 CITY OWNERSHIP OF WORK/RIGHTS IN DATA/PUBLICATIONS

- A. To the extent that Supplier creates any work subject to the protections of the Copyright Act (Title 17 U.S.C.) in its performance of a Contract, Supplier agrees to the following: The work has been specially ordered and commissioned by the City. Supplier agrees that the work is a "work made for hire" for copyright purposes, with all copyrights in the work owned by City. To the extent that the work does not qualify as a work made for hire under applicable law, and to the extent that the work includes material subject to copyright, Supplier hereby assigns to City, its successors and assigns, all right, title and interest in and to the work, including but not limited to, all copyrights, patent, trade secret and other proprietary rights, and all rights, title and interest in and to any inventions and designs embodied in the work or developed during the course of Supplier's creation of the work.
- B. Supplier shall be solely responsible for obtaining releases and/or licenses for the reproduction, distribution, creation of derivative works, performance, display, or other use of copyrighted materials. Should Supplier fail to obtain said releases and/or licenses, Supplier shall indemnify, defend, and hold harmless the City for any claim resulting there from.

1.53 DUTY OF CONFIDENTIALITY

Supplier acknowledges that unauthorized disclosure of information or documentation concerning the Scope of Work hereunder may cause substantial economic loss or harm to the City except for disclosure of information and documents to Supplier's employees, agents, or subcontractors who have a substantial need to know such information in connection with Supplier's performance of obligations under the Contract. Supplier shall not, without prior written authorization by the City allow the release, dissemination, distribution, sharing, or other publication or disclosure of information or documentation obtained, discovered, shared or produced pursuant to a Contract.

1.54 DISPUTE RESOLUTION

In the event of a dispute pertaining to a Contract, the parties agree to attempt to negotiate in good faith an acceptable resolution. If a resolution cannot be negotiated, then the parties agree to submit the dispute to voluntary non-binding mediation before pursuing other remedies. This provision does not limit the City's right to terminate.

1.55 GOVERNING LAW AND VENUE

- A. Washington law shall govern the interpretation of the Contract. The state or federal courts located in Pierce County Washington shall be the sole venue of any mediation, arbitration, or litigation arising out of the Contract.
- B. Respondents providing submittals from outside the legal jurisdiction of the United States of America will be subject to Tacoma's City Attorney's Office (CAO) opinion as to the viability of possible litigation pursuant to a contract resulting from this Specification. If it is the opinion of the CAO that any possible litigation would be beyond reasonable cost and/or enforcement, the submittal may be excluded from evaluation.

1.56 ASSIGNMENT

Supplier shall not assign, subcontract, delegate or transfer any obligation, interest or claim to or under the Contract without the prior written consent of the City.

1.57 WAIVER

A waiver or failure by either party to enforce any provision of the contract shall not be construed as a continuing waiver of such provisions, nor shall the same constitute a waiver of any other provision of the Contract.

1.58 SEVERABILITY AND SURVIVAL

If any term, condition or provision herein or incorporated by reference is declared void or unenforceable or limited in its application or effect, such event shall not affect any other provisions hereof and all other provisions shall remain fully enforceable. The provisions of the Contract, which by their sense and context are reasonably intended to survive the completion, expiration or cancellation of the Contract, shall survive termination of the Contract.

1.59 NO CITY LIABILITY

Neither the City, its officials, staff, agents, employees, representatives, or consultants will be liable for any claims or damages resulting from any aspect of this procurement process.


1.60 SIGNATURES

A signed copy of Submittals, Contract documents, including but not limited to contract amendments, contract exhibits, task orders, statements of work and other such Contract related documents, delivered by email or other means of electronic transmission including by using a third party service, which service is provided primarily for the electronic execution of electronic records, shall be deemed to have the same legal effect as delivery of an original signed copy.

SUBMITTAL CHECK LIST

This checklist identifies items to be included with your submittal. Any submittal received without these required items may be deemed non-responsive and not be considered for award.

Submittals must be received by the City of Tacoma Purchasing Division by the date and time specified in the Request for Bids page.

The following items make up your submittal package:	
Signature Page (Appendix A)	
Bid Proposal Sheet (Appendix A)	
Record of Prior Contracts (Appendix A)	

After award, the following documents will be executed:	
Contract	
Performance Bond	
Certificate of Insurance	

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- Price Proposal Sheet
- Record of Prior Contracts
- Substitution Request Form

Appendix B

- Sample Contract
- Sample Performance Bond
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TECHNICAL PROVISIONS

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Division 1

General

1.10 GENERAL

Sections in these specifications titled “*Common Work for . . .*” shall apply to all following subsections whether directly referenced or not.

Sections in these specifications titled “*Related Sections*” shall be read as integral to the specification as if they were fully detailed within. All work and materials described in such sections shall be provided and performed by the Contractor.

1.10.16 Definitions

[CSI 01 42 16]

The City of Tacoma Department of Public Utilities shall be referred to as the “City” or “Owner” throughout this document. The successful contractor is the manufacturer and supplier of the pump station to whom this contract is awarded and shall be referred to as the “Contractor” throughout this document. The City’s representative for all matters pertaining to this contract shall be the “Engineer”. The contractor who will install the pump station is referred to as the “Installation Contractor”.

Approximate: Generally as shown or described, but has not been verified, or may require adjustment. No level of accuracy is implied or should be assumed.

Or Equal (Or Approved Equal): An alternate product, assembly, or method that the Owner’s Representative has reviewed based on information provided by the Contractor and determined to provide functional equivalence, or better, than that specified. Such determination does not relieve the Contractor from responsibility should the product, process, or method fail to perform as needed.

Owner’s Representative: Person(s) authorized by the Owner to observe the work, administer the contract, approve tests, make decisions, and otherwise act as an agent of the Owner. The terms Engineer, Owner’s Observer, Owner’s Inspector, and Owner are generally interchangeable with the term Owner’s Representative.

Proposed: The word refers to work that is part of the Contract, to be performed by the Contractor. The word “proposed” does not need to show up to indicate work by the Contractor. Unless work is specifically noted to be performed by others, all work is to be performed by the Contractor.

1.11.00 Summary of Work

[CSI 01 11 00]

This project includes fabrication of packaged welded steel potable water booster pump station. The estimated total value for the work is \$900,000. To accomplish this goal several phases must be completed, including but not limited to the following:

- A. Fabrication, factory testing and delivery of a welded steel, below grade, potable water booster pump station.

- B. Transportation and delivery of the potable water booster pump station to project site within the timeline requested by the installation contractor.
- C. On-site start up and testing of potable water booster pump station.
- D. On-site training of potable water booster pump station with City staff.

The project will be located on a City of Tacoma owned property at the northwest termination of 196th Street East in Bonney Lake, Washington. Contractor will access the site from 196th Street East through an existing residential road for which the contractor shall not have exclusive access to.

1.11.02 Reuse of Documents

[CSI 01 11 30]

Contractor and any Subcontractor or Supplier shall not:

1. Have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media editions; or
2. Reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer.
3. The prohibitions of this Paragraph will survive final payment, or termination of the Contract. Nothing herein shall preclude Contractor from retaining copies of the Contract Documents for record purposes.

1.11.03 Electronic Data

[CSI 01 31 26]

1. Unless otherwise stated in the Supplementary Conditions, the data furnished by Owner to Contractor, or by Contractor to Owner, that may be relied upon are limited to the printed copies (also known as hard copies). Files in electronic media format of text, data, graphics, or other types are furnished only for the convenience of the receiving party. Any conclusion or information obtained or derived from such electronic files will be at the user's sole risk. If there is a discrepancy between the electronic files and the hard copies, the hard copies govern.
2. Because data stored in electronic media format can deteriorate or be modified inadvertently or otherwise without authorization of the data's creator, the party receiving electronic files agrees that it will perform acceptance tests or procedures within 30 days, after which the receiving party shall be deemed to have accepted the data thus transferred. Any errors detected within the 30-day acceptance period will be corrected by the transferring party.
3. When transferring documents in electronic media format, the transferring party makes no representations as to long term compatibility, usability, or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by the data's creator.

4. Computer Aided Design (CAD) files will not be made available to the Contractor. This includes AutoCAD™, Civil3D™, or other similar file types. Only printed hard copies or electronic representations of hard copies (e.g. PDF) will be provided.

1.13 Permits and Licenses

[CSI 01 41 26]

A building permit for this project has been submitted to Pierce County for approval. Other permits necessary for the completion of this project shall be the responsibility of the Contractor. The Contractor shall be responsible for paying for all permits associated with this project with the exception of the building permit.

A copy of permits the Owner has acquired are available at the Owner's office for examination by bidders. Conform to the requirements of these permits and all other permits issued for this project.

1.14 Work Restrictions

[CSI 01 14 00]

1.14.19 Use of Site

[CSI 01 14 19]

The Contractor shall not perform work activities, store materials or equipment, move equipment through, or disturb in any way the areas outside the "Building Construction Limits", "Utility Construction Limits" and "Landscaping Construction Limits", shown unless approved by the Owner in writing.

The Contractor shall provide, maintain, and adjust erosion control fencing, surface covering, and sediment traps for storm-water runoff as shown on the plans prior to beginning any work activities within this area.

1.14.22 Cold Weather Work

[CSI 01 14 22]

If the Contractor wishes to work during weather where the maximum daily temperature does not exceed 40 degrees Fahrenheit, the Contractor must submit a cold weather work plan and obtain permission from the Owner. Owner permission is not guaranteed and refusal will not be cause for claim. Any costs associated with cold weather work which may include but not be limited to: tenting; heating of workspace or materials; wind protection; snow/ice removal; testing; and removal/replacement of frozen work will be borne by the Contractor with no additional cost to the Owner.

If temperature at any time drops below freezing, the Contractor must provide freeze protection for temperature sensitive work. All costs are incidental.

1.20 PRICE AND PAYMENT PROCEDURES

[CSI 01 20 00]

Payment will be made in accordance with Division 18 of these Specifications. A schedule of values shall be provided for lump sum work.

1.21.29 Quantity Allowances

[CSI 01 21 29]

If more or fewer materials are needed when the construction quantity is within plus or minus 25 percent of the bid quantity, costs for restocking of unused materials, or handling and delivery costs on additional materials shall be incidental to the bid price and no additional payment will be made.

1.21.55 Cost Increases for Materials

[CSI 01 21 55]

There will be no allowance for additional payment should the cost of any materials go up during the original contract timeframe, or during any approved contract time extensions. The Contractor is responsible for securing prices at the time of bid.

1.30 ADMINISTRATIVE

[CSI 01 30 00]

1.31 Project Management and Coordination

[CSI 01 31 00]

Unless otherwise modified in writing to the Contractor, the Engineer shall be Carol Powers, P.E., who can be reached at (253) 381-0200. This office phone shall be used as the primary means of communication between the Contractor and the Engineer. The Contractor may also attempt to reach the Engineer at email cpowers@cityoftacoma.org. All official correspondence or information that is time sensitive shall be forward to the office phone above, or if required in writing, shall be sent to:

Tacoma Water
Attn: Carol Powers, P.E.
3628 South 35th Street
Tacoma, WA 98409-3192

Within seven (7) calendar days of the notice to proceed, the contractor shall identify in writing to the Engineer the following:

1. Phone number by which the proposed Superintendent can be reached. This phone number shall be capable of taking voice messages when the Superintendent is not available.
2. A description of any limitations on the authority of the Superintendent and the name and phone number of an officer of the Contractor's company who will act on behalf

of the Contractor in any circumstance that exceeds the Superintendent's authority. If no limitations are noted, the Superintendent shall be responsible for timely decisions on all matters relating to this contract.

3. The address to which all official correspondence shall be sent.

Changes to the above shall be made only in writing to the Engineer.

Any and all communication regarding this specification prior to bid opening will be coordinated through Tisha Rico, Senior Buyer at trico@cityoftacoma.org.

The City reserves the right to request additional information, particularly on non-demonstrated devices to ascertain acceptability prior to awarding the contract. Failure to supply requested information may be cause to reject bid as non-responsive. If there is additional information or changes regarding these Specifications, an addendum will be sent to each bidder.

1.31.01 Contractor's Responsibility

[CSI 01 31 01]

The work included in this contract is shown on the contract plans and described in these project specifications. All work incidental and necessary to the completion of the work described and shown shall be performed by the Contractor. Due to the nature of the project, it is the intent of these Specifications to obtain a product with emphasis on overall safety, quality and quality control, both during and after the construction process. Only Contractors experienced in the construction of below grade welded steel potable water booster pump stations will be considered as "responsive" and "responsible" bidders for this pre-packaged potable water booster pump station project. The Owner will determine the responsiveness of bidders in accordance with the City of Tacoma Standard Terms & Conditions Section 1.20 Evaluation of Submittals. A primary criteria will include Contractors who have successfully completed at least fifteen, below grade, welded steel pre-packaged potable water pump stations in the last ten years and a minimum of five years experience in the manufacture of similar equipment as stated in 13.32.43. The information required in this section shall be submitted with the bid package on the Record of Prior Contracts Form. Failure to submit such information will be deemed a material irregularity which may cause the bid to be rejected as nonresponsive.

The successful bidder shall provide a performance bond for 25% of the amount of the bid.

The General (or Prime) Contractor is fully responsible for providing the subcontractors and suppliers with all relevant portions of the plans and specifications necessary to bid and construct the improvements.

Damage to existing utilities or property shall be repaired or replaced by the Contractor at the discretion of the Owner.

The Contractor and each of the Subcontractors are responsible for coordinating the required inspections. There are specific requirements for inspection responsibilities and the advance notice that must be given to minimize construction delays. It is the Contractor's responsibility to be familiar with these requirements, include the coordination necessary in this estimate of project costs and schedule, and to comply with the requirements during construction. Failure

to follow proper inspection and notification procedures may result in on-site work stoppages and removal or demolition of unapproved structures or systems, all at the Contractor's expense. See Starting and Adjusting section for details.

Do not start work on this project or on any public or private right-of-way or easement until clearance is given by the Owner. It will be the responsibility of the Contractor to comply with the requirements of any permit for the project. Do not hinder private property access without a 24-hour notice to the private property owner, and do not hinder access for more than an 8-hour period. Do not disrupt emergency aid access to private property.

The Contractor is solely responsible for all elements of site safety. Inspections performed by the Owner are only to monitor and record that project plans and specifications are being complied with and construction is consistent with the design intent.

The Contractor is responsible for managing, coordinating, and overseeing its subcontractors, suppliers, manufacturers' representatives, or any other persons performing Work. The Contractor shall have a competent representative, familiar with the project and work being performed, on-site at all times.

1.31.10 COVID-19 Scheduling Provisions

Exclusion from Force Majeure. A force majeure event does not include the COVID-19 Pandemic. See Section 2, below, for information on how Contractor shall notify the Owner if Contractor desires to claim additional Time due to events attributable to the COVID-19 Pandemic.

Waiver. Contractor shall provide notice to the Owner of any delay attributable to the COVID-19 Pandemic in the manner specified in Section 2. Failure to provide notice to the Owner with regard to delays attributable to the COVID-19 Pandemic as required by Section 2 constitutes a waiver of Contractor's right to later make such a request.

Adjustment of Time for COVID-19.

1. Definitions.

- a. "COVID-19" means the novel coronavirus respiratory disease.
- b. "COVID-19 Pandemic" means the pandemic declared by the World Health Organization on March 11, 2020.
- c. "Executive Order" means any order signed by a governor restricting or prohibiting certain activities of businesses, schools, and individuals to mitigate the spread of COVID-19.
- d. "Labor shortage" means a shortage of Contractor's qualified personnel because they are on leave due to COVID-19.
- e. "Governmental health regulation" means any state or local health regulation aimed to mitigate the spread of COVID-19, including the social distancing regulation.
- f. "Supply chain disruption" means the Contractor's inability to obtain goods used to perform the Work contemplated under the Contract due to COVID-19.

- g. “Time” means any term used to define the duration the Agreement is in effect, including, but not limited to “Term” or “Contract Time.”
- 2. Contractor’s Request Required. In the event the Contractor believes that additional Time is required due to the COVID-19 Pandemic due to delays resulting from a labor shortage, a supply chain disruption, or mandated compliance with Executive Orders or governmental health regulations, the Contractor shall submit to the Owner a timely request for adjustment of Time. A request is presumed to be timely if it occurs within seven calendar days after the Contractor becomes aware of any delay caused by a reason stated in this Section. The Owner will only consider requests for adjustment of Time if the Contractor’s request provides the following information:
 - a. The date the delay began as a result of the COVID-19 Pandemic.
 - b. The cause of the delay. The Contractor must identify in the request whether the delay is due to a labor shortage, a supply chain disruption, or compliance with an Executive Order or governmental health regulation and the specific circumstances surrounding the delay.
 - c. The specific actions and efforts the Contractor is doing to limit the impact of the delay.
 - d. The date Contractor expects the delay will end, if known. If not known, Contractor shall promptly notify the Owner within seven calendar days after the delay ends.
 - e. The Owner shall be entitled to request from the Contractor all documentation necessary to evaluate Contractor’s request for more Time under this Section.
- 3. Basis for Adjustment of Time. The Owner will consider causes that include delays that affect the Contractor’s performance of Work directly attributable to the COVID-19 Pandemic such as an Executive Order, a governmental health regulation, a labor shortage, or a supply chain disruption that could not be mitigated by the Contractor’s specific actions and efforts, or by the reasonable actions and efforts the Contractor should have taken, to minimize the delay.
- 4. Consideration and Response by Owner. The Owner will only consider a Contractor’s request for additional Time if Contractor supplied all the required information described in Section 3(b). The Owner will review a properly submitted request for Time adjustment related to COVID-19, and within a reasonable time, will advise the Contractor of the Owner’s findings. If the findings determine that Contractor is entitled to additional Time, then Owner and Contractor shall execute a written change order extending the Time equal to the length of the actual delay in performance.

Termination. In addition to the termination rights in the Agreement, the Agreement may be terminated by either party by giving notice as required in the Agreement if: 1) federal or state laws, regulations, or guidelines are modified or interpreted in a way that the Work under the Agreement is prohibited; 2) recommendations, declarations or orders by state or local governments, including local health authorities and local officials, discourage or prohibit the event or scope of work that was to be performed under the Agreement; or 3) Owner is prohibited from paying for the work from the planned funding source.

1.31.11 COVID-19 Health and Safety Plan

The Contractor shall prepare a project specific COVID-19 health and safety plan (CHSP) prior to beginning physical Work.

The Contractor shall update and resubmit the CHSP as the work progresses and new activities appear on the look ahead schedule. If the conditions change on the project, or a particular activity, the Contractor shall update and resubmit the CHSP. Work on any activity shall cease if conditions prevent full compliance with the CHSP.

The CHSP shall address the health and safety of all people associated with the project including State workers in the field, Contractor personnel, consultants, project staff, subcontractors, suppliers and anyone on the project site, staging areas, or yards. The plan shall contain the following minimum elements:

1. The CHSP shall identify all standards, guidance, publications, and sources on which it is based. Those standards may include references to OHSA, WISHA, and CDC publications that are current at the time the CHSP is prepared.
2. The CHSP shall identify a responsible individual from the Contractor who is responsible for implementation of the CHSP. The individual(s) contact information shall be listed in the CHSP.
3. The CHSP shall specifically identify the project for which it is applicable, and if applicable, shall address project work areas outside the project limits such as staging areas or yards.
4. The CHSP shall identify the PPE and administrative and engineered controls necessary to maintain a safe site. This includes but is not limited to: sanitation resources, screening stations, safety briefings, controlling access, and personal protective equipment (PPE) needed to protect workers from COVID-19.
5. The CHSP shall identify measures for screening and managing workers or visitors to areas identified in the CHSP. The plan shall include procedures should a person exhibit symptoms of COVID-19.
6. The CHSP shall identify how the plan will be updated as new work activities are added with each two week look-ahead schedule. The CHSP updates shall identify the number of workers, crews, work tasks, and the degree of congestion or confinement workers will experience for the work activities in the two week look-ahead schedule.
7. The CHSP shall include how the Contractor will ensure everyone on the site has been trained on the CHSP requirements. This includes subcontractors, suppliers, and anyone on the project site.

The Contractor shall grant full and unrestricted access to the Engineer for CHSP Inspections. The Engineer (or designee) may conduct periodic compliance inspections on the project site, staging areas, or yards to verify that any ongoing work activity is following the CHSP plan. If the Engineer becomes aware of a noncompliance incident either through a site inspection or other means, the Contractor will be notified immediately (within 1 hour). The Contractor shall immediately remedy the noncompliance incident or suspend all or part of the associated work

activity. The Contractor shall satisfy the Engineer that the noncompliance incident has been corrected before the suspension will end.

1.32.13 Scheduling of Work

[CSI 01 32 13]

It is the intent of the City to award this contract and begin work as soon as possible.

The contractor shall have 196 calendar days to complete the work starting on the date of approved submittals. The contractor shall have 21 calendar days from the notice to proceed to submit drawings and calculations per Division 1.33.23 for approval. Once the booster pump station is complete, if the Installation Contractor is not ready for delivery, the Contractor will be required to store the completed pump station at a site of the Contractor's choosing upon City approval until the City is ready to receive the pump station at the location stated in these Specifications. The City shall be granted access to the pump station while in storage.

Liquidated damages may be levied against the Contractor for each calendar day the work remains uncompleted beyond the 196th calendar day after the issuance of the notice to proceed. Liquidated damages shall be \$1,000/day. Where the plans or specifications mention notification periods in hours or days, these time periods are assumed to be working days unless specifically stated otherwise. For example, a requirement of 48-hours notification for work desired to be performed at 1:00 pm Monday requires notification be provided no later than 1:00 pm the preceding Thursday.

1.32.16 Construction Schedule and Progress Schedule

[CSI 01 32 16]

Contractor is responsible for developing and providing a construction schedule within 10 working days of award and to provide an updated construction schedule monthly thereafter. If at any point, the Contractor becomes aware of an impact to the schedule of 5 days or more, the Contractor shall inform the Owner as quickly as possible. If an updated schedule is not in-line with the previous schedule, the Contractor shall note the schedule change with the submittal of the updated schedule.

1.32.29 Periodic Work Observation

[CSI 01 32 29]

The Owner may elect to have an observer on site to monitor, observe and record construction progress. The Contractor maintains complete responsibility to verify construction is meeting the design intent and is being constructed in accordance with the plans and specifications. It is not the responsibility of the Owner's observer to address neither means and methods issues nor direct safety issues. The Owner's observer does not have the authority to stop work if unsafe conditions are observed.

1.33 Submittals

[CSI 01 33 00]

1.33.23 Shop Drawings, Product Data, and Samples

[CSI 01 33 23]

When the statement “Engineer Approved Equal” is made on the drawing or in the Specification, it shall mean a like product, of equal or better quality, suitability, reliability, performance, and dimension to the specified item or product. If the Engineer does not consider the proposed substitute item or product an approved equal or better, it may be rejected. The decision of the Engineer is final.

Prior to Bid Opening

In order for alternate equipment to be considered an Engineer Approved Equal, the Bidder shall make a prebid submittal.

When the Bidder chooses to offer an alternate item or product, he shall submit complete supporting technical and physical data, including drawings, diagrams, catalog cuts, manufacturer’s specification sheets, laboratory tests, photographs, samples, the address and phone number of the nearest representative, and any other information which will allow the Engineer to accurately evaluate the item or product as equal.

Substitutions and alternate equipment will be considered prior to the bid opening if the Bidder submits his request for substitution not less than ten (10) working days prior to the date set for bid opening.

All substitution requests shall be submitted using the Substitution Request Form included in this specification and shall be sent to Tisha Rico, Senior Buyer, at tiroc@cityoftacoma.org. Substitution requests not received by the named individual will not be evaluated and not be allowed as a substitution prior to bidding. An addendum listing such approvals will be issued prior to bidding.

Bidders who do not receive prior approvals, in writing, of Engineer Approved Equals must base their bids on the items specified.

Post Award

Submittals are required for all items installed on this contract. Address submittals to:

RH2 Engineering, Inc.
22722 29th Dr. SE, Suite 210
Bothell, WA 98021
Attn: Max Freimund, P.E.
Email: mfreimund@rh2.com

Before any material is fabricated or shipped, the Contractor shall furnish to the Engineer two complete sets of subcontractor documents, equipment brochures, technical data, full details, dimensions, catalog cuts, schematic (elementary) diagrams, and other descriptive matter as required to fully describe the exact equipment proposed to be included in this contract. The

names, addresses and phone numbers for the representative of each item shall also be included.

Should any item which deviates from these Specifications be included, the deviation shall be clearly indicated and explained at the time of submittal.

The Contractor shall provide two complete copies of submittal information. Submittals shall be complete, neat, orderly, and indexed. The Contractor shall check submittals for number of copies, adequate identification, correctness, and compliance with the Plans and Specifications. The Contractor shall revise and/or resubmit all submittal information until it is acceptable to the Engineer. The City shall not be liable for any costs, either direct or indirect, incurred by the Contractor in obtaining materials that have not been submitted and approved.

Review of submittal information by the Engineer shall not relieve the Contractor of responsibility for meeting the requirements of the Plans and Specifications, or for errors and omissions in submittals. Reviews by the City do not constitute an undertaking on the part of the City to assure or determine compliance with the Plans and Specifications.

No changes may be made in any submittal after it has been reviewed except with written notice and approval from the Owner.

Submittals that do not comply with these requirements may be returned to the Contractor for re-submittal. The Contractor shall revise and resubmit as necessary. Acceptable submittals will be reviewed as promptly as possible and transmitted to the Contractor not later than 20 working days after receipt by the Engineer. Delays caused by the need for re-submittal shall not be a basis for an extension of contract time or delay damages.

Shop drawings and submittals shall contain the following information:

1. Drawings, dimensions, and weights.
2. Catalog information.
3. Model number, including descriptions for option and accessory codes.
4. Manufacturer's specifications.
5. Special handling instructions.
6. Maintenance requirements.
7. Wiring and control diagrams.
8. List of contract exceptions.

For integrated or package systems (see also 1.61.31), the components, shop drawings, instructions, and other elements may be submitted and reviewed individually. But the initial submittal must include the complete proposed system, and the final submittal must also be for the complete system clearly indicating all changes made during the submittal process.

The Contractor warrants that they have determined and verified all field measurements, field construction criteria, materials, catalog numbers, and similar data, and have checked and coordinated each submittal with the requirements of the work and of the contract documents.

The Owner will pay the costs and provide review services for a first and second review of each submittal item. Additional reviews shall be paid by Contractor by deducting up to \$200 for each hour of review time from the next scheduled payment.

The Contractor is responsible for identifying the shop drawings and submittals required for this project. Specific submittal requirements may be listed in each section of these specifications. Contractor shall keep a complete and up to date copy of all submittals and review responses at the job site readily available to the Owner for inspection.

1.40 QUALITY REQUIREMENTS

[CSI 01 40 00]

Work shall be performed in a workmanlike manner, by craftsmen skilled in the particular trade, according to best method known for each craft. Work shall be performed in accordance with the Engineer approved Plans, Specifications, Manufacturers' recommendations, and the best practices of the trade. Completed work shall present a neat and finished appearance. Lay work to true lines, plumb and level, except as otherwise noted.

1.42.19 Reference Standards

[CSI 01 42 19]

Any part of the work not specifically covered by these Specifications shall comply with applicable sections of the latest editions of: the Washington State Department of Transportation Construction Manual, Washington State Department of Transportation Standard Specifications, American Water Works Association (AWWA) Standard Specifications, American Public Works Association (APWA) Standard Specifications, including the City of Tacoma Supplement, National Electric Code (N.E.C.), the International Building Code (I.B.C.), Underwriter's Laboratories (U.L.), the laws of the State of Washington, and Tacoma Power and Tacoma Water Standards. Wherever these specifications may conflict, the above is in order of precedence, and the first specification shall control. Example: AWWA standards shall prevail over IBC standards if there is a conflict.

1.43.20 Warranty

[CSI 01 43 20]

The Contractor shall guarantee all work, materials and equipment provided under this contract to be free of defects in design, materials and workmanship for a period defined in Division 13. This warranty shall include all parts, labor and other expenses, so that no cost to the City from any warranty related problem will result.

The warranty shall not apply to incidental supplies or consumables such as lights and batteries. The City will agree to repair or replace light bulbs, batteries, and other incidentals at no cost to the Contractor.

Warranties and guarantees by suppliers of various components in lieu of a single source responsibility by the Contractor will not be accepted. The Contractor shall be solely responsible for the warranty of the station and all components; mechanical, electrical, physical or otherwise except as noted below. S&B Inc. of Bellevue has agreed to warranty their

provided equipment and work for two (2) years, so if failure results from S&B's work, the Contractor shall require S&B to correct said work in accordance with the requirements herein.

NOTE: Where the manufacturer/supplier's warranty for a specific piece of equipment extends beyond that of the pump station warranty, that warranty shall also be supplied, and shall be fully transferable to the City.

Warranty does not cover damage due to misuse by the Owner or conditions outside of the Owner or Contractor's control or exceptional events (force majeure) including war, strikes, floods (water exceeding normal high water mark), rainfall in excess of 100 year storm event, fire, earthquakes, high winds (over 85 mph for 3 seconds peak gust), freezes below 10 degrees Fahrenheit (Western Washington), freezes below minus 10 degrees Fahrenheit (Eastern Washington), governmental restrictions, vandalism, utility power failures, or utility power surges (unless due to Contractor provided surge suppressor failure).

1.45.16 Field Quality Control Procedures

[CSI 01 45 16]

Unless otherwise noted on the plans or within these specifications, provide 48-hour notice to the Owner and appropriate reviewing agency for all inspections required. 48-hour notice is defined as two complete working day notice. Time is not counted on weekends and holidays (inspections required on a Monday or the day after a holiday shall be scheduled a minimum of 48 hours in advance not including the holiday hours or weekend hours.)

Contractor shall schedule and arrange for the following inspections and tests with the appropriate reviewing agency and testing company.

- Special Inspections as required per IBC Division 17 and as noted on the drawings
- Any additional inspections required by the Building Department, or other approval agency
- Soils and crushed rock compaction
- Asphalt materials and compaction
- Steel tank welds
- Steel tank coatings
- Paint thickness and finished quality
- Pressure testing
- Water quality testing

1.50 TEMPORARY FACILITIES AND CONTROLS

[CSI 01 50 00]

1.54 Construction Aids

[CSI 01 54 00]

The Contractor or product manufacturer may include work, materials, or components to aid in shipping, storage, installation, or other work for their convenience. Such items shall be removed prior to final project acceptance if they may interfere with the operation or maintenance of permanent work. Some examples include, but are not limited to:

- Lifting eyes: Remove only if a safety concern, obstruction, or directed by Owner.
- Picking holes: Plug holes of buried and exterior items, or if safety concern.
- Intermediate or shipping bracing: Remove and dispose.
- Protective shipping adhesives, coatings, or covers: Remove and clean residue.

1.60 PRODUCT REQUIREMENTS

[CSI 01 60 00]

1.61 Common Product Requirements

[CSI 01 61 00]

Unless otherwise indicated, provide all high quality, new and unused materials, free from any defects, and suitable for the intended use and the space provided. All materials shall be the best available for the purpose intended as dictated by the best current engineering practice. Materials shall be approved by the latest Standards of Underwriters Labs (UL), American Society for Testing Materials (ASTM), Factory Mutual (FM), American Water Works Association (AWWA), and National Electrical Manufacturers Association (NEMA), wherever standards have been established by those organizations.

Furnish and install all incidental items not specifically shown or specified, which are required by good practice to provide a complete and fully operational system.

Where two or more units of the same class of material or equipment are required, provide products of a single manufacturer/supplier.

1.61.31 Integrated (or Package) Products

[CSI 01 61 31]

Products specified as integrated or packaged must be administered with a single point of responsibility from a producer who regularly furnishes such products and is qualified to address and resolve issues during submittals, fabrication, installation, commissioning, and operation. These responsibilities will not be transferred to any other party without written approval by the Engineer. Products that fall under this category may include but are not limited to the following (when specified as packaged or integrated).

- Pump stations
- Control systems

The Contractor shall deliver all equipment to the project site. The Contractor shall hold the completed pump station at a secure site of their choosing until the Installation Contractor is ready for delivery. The Contractor shall coordinate with the Installation Contractor for delivery to the project site.

Contractor shall notify the Engineer in writing when the pump station has been delivered to the project site and ready for inspection. The Contractor shall authorize representatives of the City, including the Engineer, to enter the pump station and inspect the pump station for compliance with these Specifications and forward the results to the Contractor. If it is determined, by the Engineer, that the pump station does not conform to these Specifications, or is not in satisfactory condition, the Contractor shall correct the deficiencies to the satisfaction of the Engineer.

The Contractor shall notify the Engineer in writing when all punch list deficiencies have been completed. The Engineer will promptly set a time for final inspection, at which time the Engineer, and the Contractor shall jointly inspect the work. The Contractor will promptly correct any further deficiencies noted.

1.70 EXECUTION AND CLOSEOUT REQUIREMENTS

[CSI 01 70 00]

1.75 Starting and Adjusting

[CSI 01 75 00]

1.75.16 Startup Procedures

[CSI 01 75 16]

1.75.16.10 Startup

[CSI 01 71 16 10]

See the Automatic Control section for control system startup.

The startup will occur based on the Installation Contractor's schedule. A minimum of two weeks' notice of the projected startup dates will be provided.

The Contractor shall provide an experienced and authorized representative to coordinate and oversee the startup for the pump station. The startup testing and functional acceptance testing shall last for approximately two (2) full days.

The Contractor shall be responsible for all operations testing (see Division 13.32.43). The Engineer and the City's operating personnel will witness and assist operations testing.

It is not the intent of the Engineer to instruct the Contractor in the startup of each facility; however, the Engineer will be available prior to and during start up to provide technical support to the Contractor.

The Contractor shall be required to start up the facility, under direction of the City, operate it, and pass the startup test, prior to acceptance. The “startup test” shall consist of successfully running all mechanical, electrical, and instrumentation components to the Engineer’s satisfaction.

To begin the startup of the pump station, the Installation Contractor will close the main service disconnect switch (external to the pump station and installed under a separate contract) to power up the pump station. The Installation Contractor will also operate any valves external to the pump station and will cause the pipelines to slowly fill with water.

The startup shall not be commenced until all required leakage tests and equipment test have been completed to the satisfaction of the Engineer. No leakage will be allowed.

All components of the pump station shall be tested in manual, hand or local control, first. The pump station shall be run and tested in the manual mode for not less than eight (8) hours. The Contractor shall provide a minimum of one (1) day to do the startup and as many days as necessary to correct any problems found during the testing of the facility.

All defects in materials or workmanship or functionality which appear during this test period shall be immediately corrected by the Contractor and/or Installation Contractor. Time lost for equipment repairs, wiring corrections, control point settings, or other reasons which actually interrupt the startup may, at the discretion of the Engineer, be justifiable cause for extending the startup test duration.

After this test period has been successfully completed, the pump station and all of its components shall be tested in the automatic and remote modes. The pump station shall be run and tested in the automatic mode for not less than eight (8) hours. The Contractor shall provide a minimum of eight (8) hours to coordinate and witness the functional acceptance test with the System Integrator, Installation Contractor and Engineer, as specified in Division 13.32.43 for the facility.

All defects in materials, workmanship or functionality which appear during this test period shall be immediately corrected by the Contractor and/or the System Integrator.

During the startup, the Contractor shall maintain records of operations and startup in accordance with good industry practice and the instructions of the Engineer.

1.75.16.12 Startup and Testing Coordination

[CSI 01 75 16 12]

The Contractor shall conduct all testing and startup. Testing and startup shall not be a cause for claims for delay by the Contractor and all expenses for testing and startup shall be incidental to this contract.

The placing of all improvements in service shall consist of three parts: “testing”, “startup”, and “operation”. Not less than 21 calendar days before the anticipated time for beginning testing, the Contractor shall notify and submit to the Owner for approval, a complete plan for the following:

1. Schedules for tests:

- A. Telemetry Panel Factory Demonstration Test (at panel shop)

- B. Pumps and motors
 - C. Control system
 - D. Treatment system
 - E. Meter calibration
 - F. Emergency power system
2. Detailed schedule of procedures for startup.
 3. Complete schedule of events to be accomplished during testing.
 4. An outline of work remaining under the contract that will be carried out concurrently with the operation phases.

Failure to provide proper notification to the Owner may lead to liquidated damages if schedule cannot be maintained. If rescheduling is required because components are not ready for testing, the notification requirements are reset as needed to provide 21 calendar days advance notice to reserve the Owner Representatives' time.

The Contractor shall arrange for all materials, supplies, and labor necessary to efficiently complete the testing, startup, and operation. Measuring devices must be functional, accurate, legible, and scaled appropriately for the test. The Owner has the right to reject or require verification for any measuring device the Owner suspects in its accuracy.

At a minimum, the Contractor shall provide:

- Calibrated pressure gauge(s) (max scale of 120% to 200% of test pressure)
- Air compressor
- Voltmeter
- Amp meter.
- Load Bank (generator testing)
- Sound Level (dB) measuring device (generator testing)
- Pump/motor vibration measuring device (inches per second and inch peak to peak)

Work under other contracts will occur concurrently with this project. The Contractor shall incorporate the schedules of the other work. Work by others includes:

- SCADA programming and testing: 2 months.
- Delivery of pre-packaged, below grade Booster Pump Station: 7 months.

Tacoma Water needs to make system changes prior to startup of the pre-packaged, below grade Booster Pump Station and Tacoma Water shall provide written approval that they are accepting of the Booster Pump Station startup schedule prior to the startup taking place. Startup of the pre-packaged, below grade Booster Pump Station and the Emergency Generator shall be complete prior to startup of the reservoir.

1.75.16.20 Testing

[CSI 01 75 16 20]

The Contractor may periodically request preliminary testing for items that must be covered or tested before other work can proceed. In these cases, do not cover up or test the work without timely notice to the Owner of its readiness for testing. Should any work be covered up without notice, approval, or consent, it must, if required by the Owner, be uncovered for examination at the Contractor's expense. All necessary equipment shall be set up and the work given a preliminary test so that defects may be discovered and repaired prior to calling out the Owner to witness the test.

Final testing consists of individual tests and checks made on equipment intended to provide proof of performance, operation, and control in the presence of the Owner. Assure proper alignment, size, condition, capability, strength, adjustment, lubrication, pressure, hydraulic test, leakage test, and all other tests deemed necessary by the Owner to determine that all materials and equipment are of specified quality, properly situated, anchored, and in all respects ready for use. Any certificates required in these specifications by the manufacturer's representatives shall be supplied to the Owner prior to startup.

All piping shall be tested as required by specifications and applicable codes. Tests on individual items of equipment shall be as necessary to show proper system operation. During testing, the Contractor shall correct any defective work discovered. Startup shall not begin until all tests required by these specifications have been completed and approved by the Owner.

Not less than five working days before the anticipated time for beginning the testing, the Contractor shall provide a list of representatives that will be attending the testing. The Owner may request additional representatives at no additional cost if said representatives are identified in these specifications.

Qualified product representatives to be on site for the following equipment, at a minimum:

- Packaged Pump Station

Additional representatives required may be identified elsewhere in these specifications.

Qualified product representatives are to be on site for startup and testing of specific pieces of equipment. Representatives required are listed in the relevant specification sections.

1.75.16.22 Scheduling of Owner Review for Testing

[CSI 01 75 16 22]

See Division 1.75.16.10 for scheduling and notification requirements.

The Contractor shall provide notification two working days and two working hours (to confirm readiness) of the scheduled test(s) to the Owner confirming that the Contractor has successfully completed all preliminary testing and that all equipment, tools, materials, labor, subcontractors, manufacturer's representatives, and all other items required for witnessed testing are available and fully functional. Failure to provide advance notification and confirmation or meet any of the testing requirements will constitute a failed test in accordance with the section Inspection and Tests of the General Conditions.

A detailed testing schedule shall be provided by the Contractor and updated as needed to be at least 48 hours ahead of actual testing. If testing requires downtime in order to perform repairs due to failed test, the Contractor shall pay the Owner in the amount of \$200 per hour per Owner Representative on site (minimum of \$400 per scheduled visit) for downtime lasting longer than 2-hours required to complete repairs to verify the complete construction is ready for startup and operation. This amount will be deducted from the appropriate bid item that relates to the finished construction and documented by the Owner at their discretion. The Contractor must have all systems pre-tested prior to calling the Owner for formal testing.

Schedule shall include control system testing starting on Mondays or Tuesdays so that the remainder of the week can be used to identify the stability of the control system for the SCADA system, pump station, or treatment plant. Control system testing shall not start on a Thursday, Friday, or the day before an Owner recognized holiday.

1.75.16.32 Pump Testing

[CSI 01 75 16 32 or 33 08 00]

See the applicable pump sections of these specifications for pump testing requirements.

1.75.16.40 Electrical and Control Systems Testing

[CSI 01 75 16 40 or 25 08 00 or 26 08 00]

See also the applicable electrical sections for electrical system testing.

See also the applicable automation sections for automatic control system testing.

The following is a list of components that shall be tested prior to project completion. This list is intended as a general guide and is not necessarily complete:

- Pressure sensors and alarms
- Flow sensors and alarms
- Temperature sensors and alarms
- Intrusion sensors and alarms
- Motion sensors
- Photovoltaic sensors
- HVAC controls
- Local control
- Automatic control

1.78 Closeout Submittals

[CSI 01 78 00]

1.78.23 Operation and Maintenance Data

[CSI 01 78 23]

Failure to provide acceptable final documentation including operation and maintenance (O&M) manuals and as-built drawings will result in non-payment of the appropriate bid item in the schedule of prices.

See also the Automatic Controls section for additional requirements for automatic control systems manuals. Detailed requirements for specific equipment and systems may also be included in their respective specification sections.

The Contractor shall remove and preserve all tags and instructions that come packaged with or attached to equipment used on the project. Deliver all such documents to the Owner bound in a three-ring binder or with the Operation and Maintenance Manual. Insert documents in sleeves if they cannot be punched. Scan all such documents to Adobe PDF format and provide with the Operation and Maintenance (O&M) Manual.

Prior to the receipt of payment for more than 90 percent of the work, the Contractor shall deliver to the Owner acceptable manufacturer's operating and maintenance instructions covering equipment and systems installed on the Project requiring operational and/or maintenance procedures and for any additional items indicated by the Owner, including coatings furnished under this contract.

The operating and maintenance instructions shall include, as a minimum, the following data for each coating and equipment item:

Products

- A. Identification including brand name, model number, and serial numbers.
- B. Date of manufacture and date of installation on job site.
- C. Complete as-built elementary wiring and one-line diagrams.
- D. Complete parts list, by generic title and identification number, complete with exploded views of each assembly.

Maintenance

- A. Recommended spare parts.
- B. Lubrication schedule including the applicable lubricant designation available from the Standard Oil Company of California.
- C. Recommended preventive maintenance procedures and schedules. Schedule shall be provided for daily, weekly, monthly, quarterly, semi-annually and annually maintenance.
- D. Disassembly and re-assembly instructions including parts identification and a complete parts breakdown for all equipment.

- E. Weights of individual components of each item of equipment weighing over 50 pounds.
- F. Name, location, and telephone number of the nearest suppliers and spare parts warehouses.
- G. All manufacturers' warranties. Include name, address, and telephone number of the manufacturer's representative to be contacted for warranty, parts, or service information.
- H. Cleaning, repair, and maintenance instructions for each coating system.
- I. Provide USB flash drive or DVDs utilized in the manufacturer's instruction program.

Operation

- A. Recommended trouble-shooting and startup procedures.
- B. Recommended step-by-step operating procedures.
- C. Emergency operation modes, if applicable.
- D. Normal shutdown procedures.
- E. Long term shutdown (mothballing) procedures.
- F. Equipment specifications and guaranteed performance data.
- G. General manuals which describe several items not in the contract will not be accepted unless all references to irrelevant equipment are neatly eradicated or blocked out.

Provide 3 hard copies of O&M manuals. A duplicate CD or thumb drive copy shall be provided but shall not substitute for a hard copy unless approved by the Owner.

Each set of instructions shall be bound into multiple volumes; each volume to be complete with an index and bound in a suitable, hard-covered binder. Binders shall be of hardback construction with full-length metal hinge. Capacity shall be 3-inch to 5-inch as appropriate for the quantity of O&M documentation. More than one binder may be required for large projects. Binders shall be equal to Wilson-Jones WLJ344 series or WLJ369 series or Specialty Loose Leaf models 87784, 98085, 98086, or 98984.

Manuals shall be assembled and indexed so that information on each coating and piece of equipment can be readily found.

Progress payments for the total contract work in excess of 90 percent completion may not be made until the operation and maintenance manual has been delivered and approved by the Owner, at their discretion.

The Contractor shall secure and deliver to the Owner all equipment warranties and other warranties and guarantees required for all equipment and processes. Delivery shall be done at one time covering all major and minor equipment warranties. Copies of the warranties shall be included in each O&M Manual.

See Division 1.43.20 for details regarding required warranties for specific components.

1.78.39 Project Record Documents

[CSI 01 78 39]

Prior to receiving final payment for the work, deliver a complete set of “As-Constructed” records (also called as-built, or record plans) to the Owner. The Owner has sole discretion to determine if the records provided are legibly and accurately presented and may request revisions, which shall be provided by the Contractor at no additional cost. Records shall be made as follows or as approved by the Owner:

- Yellow markings or highlights = deleted items
- Red markings = new or modified items

The Contractor shall provide “as-built” information on all items and work shown on the plans showing details of the finished product including dimensions, locations, outlines, changes, manufacturers, etc. The information must be in sufficient detail to allow the Owner’s personnel to locate, maintain, and operate the finished product and its various components.

See also electrical plan requirements in Division 16.05.

1.79 Demonstration and Training

[CSI 01 79 00]

1.79.10 Training

[CSI 01 79 10]

See the Automatic Control section for automatic control systems training.

At the time that the facility is ready to be put into operation, the Contractor is to conduct an operation and maintenance training meeting with the Owner to explain in detail the operation and maintenance requirements of each of the facility’s components. The training meeting shall not occur on the same days as a startup.

Operation of the facility shall commence immediately after completion of testing, startup, and training and after satisfactory repairs and adjustments have been made.

1.80 PERFORMANCE REQUIREMENTS

[CSI 01 80 00]

1.81 Facility Performance Requirements

[CSI 01 81 00]

1.81.30 Seismic Restraint and Anchorage

[CSI 01 81 30]

Contractor shall furnish seismic restraint for all architectural components, equipment, tanks, piping, valves, conduit, and other mechanical and electrical components. Seismic restraint shall be designed to meet IBC (ASCE 7 Chapter 13 – “Seismic Design Requirements for

Nonstructural Components”) code requirements. The following design values shall be used in calculating seismic forces:

$I_p = 1.5$	$S_{ds} = 0.966$	Seismic Design Category = D
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A complete seismic restraint system shall be provided including struts, straps, bolts, nuts, washers, etc. as required for secure attachment to foundations, pads, ceilings, floors, and/or walls.

Contractor shall submit either of the following in accordance with ASCE 7, 13.2.1 for all components:

1. Project-specific design and documentation prepared and submitted by a registered design professional.
2. Submittal of the manufacturer’s certification that the component is seismically qualified by
 - a. Analysis
 - b. Testing in accordance with the alternative set forth in ASCE 7, Section 13.2.5.
 - c. Experience data in accordance with the alternative set forth in ASCE 7, Section 13.2.6.

Special Certifications are required for the following systems for Seismic Design Categories C, D, E, and F. Systems shall be certified in accordance with ASCE 7, 13.2.2.

1. Mechanical and electrical equipment that must remain operable following the design earthquake. All mechanical and electrical equipment installed under this project falls under this category.
2. Components with hazardous contents.

All materials and fabrication shall be as required in these specifications. Contractor shall submit this information to the Owner for review prior to fabrication and installation.

Install seismic restraints when called for in the contract or recommended by the product manufacturer. Install in accordance with the manufacturer’s requirements as applicable.

Seismic restraint systems shall be installed so as not to interfere with normal operations and maintenance of the equipment and other components as shown on the plans. Interference with normal operations and maintenance shall be as determined by the Owner. Drilled-in anchors for non-rotating equipment shall be Concrete Anchors unless otherwise specified.

1.81.40 Pressure Ratings

[CSI 01 81 40]

Fittings, valves, pipe, and other fluid systems shall have pressure ratings equal to or greater than the pressures identified herein, unless specifically called out otherwise in the plans or specifications. Pressures listed are gauge pressure, unless specified otherwise.

The pressure class of pipelines and appurtenances shall comply with the Owner’s standards for minimum pressure class or the pressure class that meets the requirements of this section, whichever is greater.

Equipment Function	Working Pressure	Test Pressure
Reservoir Inlet and Outlet Pipe and 950 Zone Piping	30 psi	250 psi
Overflow and Drain Discharge Pipe	35 psi	100 psi
Booster Pump Station Discharge Pipe and 1010 Zone Piping	60 psi	250 psi

Working Pressure: Manufacturer's rating of maximum pressure during extended operation.

Test Pressure: Maximum pressure during project specific testing.

1.81.45 Location Designations

[CSI 01 81 45]

The following location designations shall be used except where otherwise noted on the plans:

Dry Locations: Indoor continually dry areas including office, laboratory, blower, and electrical rooms.

Wet Locations: All locations exposed to the weather, whether under a roof or not, or within channels, basins or tanks.

Damp Locations: Process areas; areas containing pumps, valves, and major piping; all spaces wholly or partially underground, or having a wall or ceiling forming part of a channel or tank, unless otherwise designated on the Plans. Any areas which do not fall within the definitions for dry, wet, or corrosive shall be considered damp.

Corrosive Locations: Areas where chlorine gas under pressure, sulfuric acid, or liquid polymer are stored or processed, sewer wetwells and sewer manholes.

Immersed or Submerged Locations: Areas which are periodically, or continuously submerged in, or contain a liquid.

Division 9

Finishes

9.00 GENERAL

This division covers work necessary for providing all materials, equipment, and labor to coat all items in accordance with these specifications.

Sections in these specifications titled “*Common Work for . . .*” shall apply to all following subsections whether directly referenced or not.

9.90 PAINTING AND COATING

[CSI 09 90 00]

9.90.05 Common Work for Painting and Coating

[CSI 09 90 05]

Part 1 – General

Scope

The work specified in this Section covers the furnishing and installation of protective coating, complete in place.

Submittals

Before beginning any painting or coating, submit a list of coatings and manufacturers intended for use for review by the Owner. Include the application each coating is intended for, any surface preparation, number of coats, method of application, and coating thickness.

Provide Safety Data Sheets (SDS) for all materials to be used including solvents. Provide NSF certification for all finishes in potential contact with potable water. Submit this information in accordance with the requirements regarding shop drawings included herein.

Provide manufacturer’s approval of coating system applicator.

If product being used are manufactured by a company other than the specified reference standard, provide complete comparison of proposed products with specified projects including application procedures, coverage rates, and verification that product is designed for intended use. Information must also be provided that demonstrates that the manufacturer’s products are equal to the performance standards of products manufactured by Tnemec Corporation, which is the reference standard.

Performance Requirements

All finishes potentially in contact with potable water shall be National Sanitation Foundation (NSF) certified for contact with potable water. Certification from the NSF or UL shall be supplied in writing at the time of the submittal process for Finishes. Contractor shall be responsible for verifying all finishes used on the project are compliant with primary and secondary standards of the Safe Drinking Water Act. Any violation shall be remedied at the Contractor’s expense.

The completed coating shall produce a minimum dry film thickness in accordance with the specifications as determined by the microtest thickness gauge or comparable instrument. In areas where this thickness is not developed, sufficient additional coats shall be applied to produce it.

Quality Assurance

The Contractor shall be responsible for compatibility of all shop and field applied paint products including the use of primer, intermediate and top coats by different manufacturers if applicable. For any Contractor initiated substitutions, the Contractor shall verify complete compatibility between coatings provided for the project. If coatings are not compatible per manufacturer's review it shall be the Contractor's responsibility to remove incompatible coatings fully and replace with compatible coating systems.

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.

The Contractor shall be responsible for obtaining written documentation from equipment/material manufacturers regarding the date at which shop prime coatings are applied and shall strictly adhere to the coating manufacturer's recommendations for recoat time intervals. The Contractor shall submit to the Engineer such documentation upon request.

Part 2 – Products

Manufacturers

The following coating system manufacturers are approved subject to compliance with the Specifications contained herein:

1. Tnemec Company
2. Sherwin Williams
3. Or Equal

The specified coating shall be understood as establishing the type and quality of the 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 coating shall be submitted for review in accordance with Division 1. 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.

Substitutions of the coatings of other manufacturers shall be considered only if equivalent systems of coatings can be provided and only if a record of satisfactory experience with the system in equivalent applications is available. Offers for substitutions will not be considered which decrease film thickness, solids by volume or the number of coats to be applied or which propose a change from the generic type of coating specified herein. All substitutions shall include complete test reports to prove compliance with specified performance criteria.

Part 3 – Execution

Preparation

Prepare surfaces in accordance with the recommendations of the manufacturer of the coating to be applied to the surface, or the surface preparation requirements of these specifications, whichever are stricter. In general, all surface preparation shall meet Structural Steel Painting Council (SSPC) Surfacing Preparation (SP) guidelines, the National Association of Pipe Fitters (NAPF), American Water Works Association (AWWA) and/or the National Association of Corrosion Engineers (NACE) as noted herein unless more strictly described by coating manufacturer.

Coatings shall only be applied during weather meeting the recommendations of the coating manufacturer. Air and surface temperatures, humidity, and all other environmental conditions shall be within limits prescribed by the manufacturer for the coating being applied, and work areas shall be reasonably free of airborne dust at the time of application and while coating is drying.

Materials shall be mixed, thinned, and applied according to the manufacturer's printed instructions. Dry Film Thickness (DFT) shall be as stated here in or applied based on coverage rates of square feet per gallon (sq. ft./gal).

Installation/Construction

Paint application shall be in strict accordance with manufacturer's printed instructions except that coating thickness specified herein shall govern. Finished coating on all items shall be clean, undamaged, and of uniform thickness and color.

Coating shall be done in a manner satisfactory to the Owner. The dry film thickness listed in the "Materials" section of this Division must be met, regardless of the applied film thickness or number of coats.

Carefully observe all safety precautions stated in the manufacturer's printed instructions. Provide adequate ventilation and lighting at all times.

The manufacturer's recommended drying time shall be construed to mean "under normal conditions". Where conditions are other than normal because of weather, confined spaces, or other reason, longer drying times may be necessary. The manufacturer's recommendation for recoating time intervals shall be strictly adhered to.

Pipe shall be emptied of water for a minimum of 24 hours prior to surface preparation and painting. Pipe shall not be filled with water until coating is dry. Do not allow water to flow for at least 24 hours after final coating.

Field Quality Control

The prime Contractor shall be completely responsible for coating quality. The Contractor shall provide both wet and dry film gauges and make such available to the Engineer when requested.

If coating inspector finds anomalies and/or defects requiring further testing or blasting and recoating, a meeting shall be held by all involved parties (coatings manufacturer representative, coating applicator, and primary coating inspector) to come to a complete resolution as to the cause of the defect. All such remedies to repair defects shall be paid for by the Contractor.

Acceptance of the completed coatings shall be based on the proper application and proper preparation of the coated surfaces, and a finished product that meets minimum thickness and does not contain runs, drips, surface irregularities, overspray, color variations, scratches, pinholes, holidays, and other surface signs that detract from the overall performance and/or appearance of the finished project.

Contractor's Record

The Contractor shall maintain daily records showing:

1. Start date of work in each area.
2. Date of application for each following coat.
3. Moisture content and surface temperature of substrate; weather conditions including ambient air temperature and dew point.
4. Provision utilized to maintain temperature and humidity of work area within coating manufacturer's recommended ranges.

Manufacturer's Record

A technical representative from the painting manufacturer shall review the process and completed finish work on site. Any defects found by the paint manufacturer's technical representative or the owner's representative shall be repaired to their satisfaction at Contractor's expense.

Manufacturer technical representative shall provide a written report that includes the following:

1. Verify coatings and other materials are as specified.
2. Verify surface preparation and application are as specified.
3. Verify DFT of each coat and total DFT of each coating system are as specified using a dry film thickness gauge.
4. Note defects that would adversely affect performance or appearance of coating systems.
5. Describe inspections made and actions taken to correct nonconforming work.
6. Report nonconforming work not corrected.
7. Submit copies of report to Engineer and Contractor.

Repair/Restoration

Scratched, chipped, or otherwise damaged coatings, including factory coatings prior to delivery, shall be repaired before final acceptance will be given.

Cleaning

If any cleaning of equipment at the site is performed with solvents, such work shall be done over leak-proof linings. Preparation or coating materials may not be disposed of onsite.

9.90.06 Color Schedule

[CSI 09 06 90 or 09 90 06]

Colors used for finish coatings on process equipment, piping, and building surfaces shall conform to the following schedule. All finishes shall be glossy unless otherwise specified. Finish coatings, which are applied in the shop by the manufacturer, shall conform to this section. Factory coatings which are damaged during shipment or installation shall be recoated in the field in accordance with these specifications.

Items of similar purpose shall be painted the same color. If items come from the factory with a shop applied coating that does not match said color, they shall be field coated to match.

The contractor shall allow no less than 15 working days from the time the Owner is provided with color selections for the Owner to make color choices.

The Owner will finalize the color schedule for painted items after award of the contract. The schedule outlined below shall be used for bidding purposes. Contractor shall provide a pallet of colors from the manufacturer of not less than 30 color choices.

9.90.13 Unpainted Items

[CSI 09 90 13]

Part 1 – General

Summary

Do not coat aluminum or stainless-steel items unless specifically directed otherwise below or on the Plans. Field painting is not required for factory prefinished equipment items (e.g. pumps, motors, blowers, etc.) unless otherwise specified. Do not coat shop epoxied meters or control valves unless noted otherwise on the Plans or herein. Do not coat small diameter pilot systems such as galvanized iron, copper, or brass pipe and fittings associated with control valves or sensors unless noted otherwise on the Plans or herein.

Do not coat over nameplates, labels, or identification tags.

9.91 Painting and Coating

[CSI 09 90 00]

Part 1 – General

Related Sections

Refer to 9.90.05 for coating application requirements.

9.91.13 Exterior Painting

[CSI 09 91 13]

9.91.13.02 – System 1 - Powder Coating for Steel and Aluminum Handrail and Other Architectural Features

[CSI 09 91 13 14]

Part 1 – General

Performance Requirements

The powder-coat shall have the following properties:

1. Adhesion: No less than 100 percent (cross hatch/tape adhesion test per ASTM D3359-97).
2. Color/Gloss Change: None below 80 percent over-bake (test per ASTM D2454-79).
3. Hardness: No less than 1H minimum (pencil hardness test per ASTM D3363-00).
4. Resistance to Impact: No less than 160-inch lb. direct and inverted. (ASTM D2794)
5. Resistance to Bending: No visible cracking (1/4-inch bending test per ASTM 522).
6. Resistance to Salt Spray: No more than 1/8-inch scribe creep in 1000+ hours (salt spray test per ASTM B117-73).
7. Resistance to Humidity: No visible red rust under 1,000+ hours (humidity test per ASTM D2247-68).
8. Degree of Gloss: No less than 60 percent (specular gloss test per ASTM D523-80).

Part 2 – Products

1. Polyester System
 - a. Primer: 3M Scotchkote fusion bonded epoxy (2 to 4 Mil DFT)
 - b. Finish Coat: Valmont polyester powder coating with UV stabilizers (2 to 4 Mil DFT)
2. Sherwin Williams Powder Coat System
 - a. Primer: Powdura Gray Epoxy Primer (1.8 to 3 Mil DFT)
 - b. Finish Coat: Powdura TGIC Powder Coating (2 to 3 Mil DFT)

Part 3 – Execution

Construction

Cure in an oven at temperatures required by the powder coating manufacturer.

Preparation

Sandblast all parts and treat with iron phosphate and seal with non-chromic process.

Field Quality Control

Finished coating shall be smooth to the touch with no visible lumps, bumps, or cracks.

9.91.13.13 - System 2: Ferrous Metal including Cast/Ductile Iron Pipe (Atmospheric Indoors and Outdoors)

[CSI 09 91 13 20]

Part 1 - General

This Section applies to all ductile/cast iron and ferrous metals, including exterior of welded steel pipe, bituminous coated pipe and materials unless specified otherwise. Do not coat stainless steel materials unless specified otherwise. This Section applies to all pipe materials and equipment, including manufacturer applied coating systems. For the purposes of this coating system, metals which are located below the top of the exterior wall within a water bearing structure or are located within a vault or manhole shall be considered as under immersion service conditions.

Part 2 - Products

1. Tnemec
 - a. Primer: Series 66 Hi-build Epoxoline (5 to 6 Mil DFT) – Sky Blue color
 - b. Finish Coat: Series 73 Endura-Shield (4 to 5 Mil DFT) – Robins Egg Blue color
2. Sherwin Williams
 - a. Primer: Corothane 1 Mio-Zinc Primer (2.5 to 3.5 Mil DFT)
 - b. Intermediate: Macropoxy 646FC B58-600 Series (6 to 8 Mil DFT)
 - c. Finish: Macropoxy 646FC B58-600 Series (6 to 8 Mil DFT)

Part 3 - Execution

Surface Preparation

1. Ferrous Metals
 - a. SSPC-SP10 Near white blast cleaning
2. Ductile and Cast-Iron Materials
 - a. It is strongly recommended that any ductile iron or cast-iron pipe or materials to have a special exterior coating should be purchased factory primed without the standard asphalt coating. Field removal of asphalt coatings is extremely difficult and overly aggressive preparation can create a damaged surface unsuitable for coating.
 - b. All oils, grease, and other contaminants shall be removed using solvent cleaning prior to abrasive blasting or power tool cleaning. Blemishes or staining on the prepared surface are acceptable if such items cannot be removed by light scraping with a knife. SSPC-SP10 blue-gray with surface profile of 2.0 Mil, minimum. Do

not burnish the surface. Clean all surfaces of dust and loose residue immediately prior to coating. See NAPF 500-03-04/05.

9.91.23 Interior Painting

[CSI 09 91 23]

9.91.23.01 – System 3: Metals Interior (Dry Conditions)

[CSI 09 91 23 13]

Part 1 - General

This Section applies to all interior metals located indoors, not factory coated and where the metal is not holding or in direct contact with a liquid and not exposed to weather.

Materials

1. Tnemec
 - a. Primer: Series 1 Omnithane Prime (2.5 to 3.5 Mil DFT)
 - b. Finish Coat: Series N69 Epoxoline II (4 to 6 Mil DFT)
2. Sherwin Williams
 - a. Primer: Corothane 1 Galvapak Primer B65G11 (2.5 to 3.5 Mil DFT)
 - b. Finish: Macropoxy 646FC B58-600 Series (4 to 6 Mil DFT)

Part 3 – Execution

Surface Preparation

SSPC SP1 followed by SP6 (commercial blast). Surface profile shall be 2.0 Mil, minimum.

9.91.23.03 - System 4: Galvanized Metal Surface Repair

[CSI 09 91 23 14]

Part 1 - General

This Section applies to all galvanized surfaces which have received minor damage to the galvanized surface during construction and require repair.

Part 2 - Products

1. Tnemec
 - a. First Coat: Series 90-97 Tneme-Zinc (2.5 to 3.5 Mil DFT)
2. Sherwin-Williams
 - a. First Coat: Corothane 1 Galvapak B65G11 (2.5 to 3.5 Mil)

Part 3 - Execution

Surface Preparation

1. SSPC-SP3 Power tool cleaning

9.91.33 Submerged and Buried Metals Painting

[CSI 09 91 33 or 09 97 00]

9.91.33.01 - System 5: Metals in Contact with Drinking Water (Steel pipe, pump suction head interior, pump discharge head interior)

[CSI 09 91 33 13]

Part 1 – General

Summary

This section applies to all metals in contact with potable drinking water.

References

Coatings shall be NSF 61 approved for use in direct contact with potable drinking water. The NSF 61 approval shall be appropriate for the application.

Part 2 – Products

Materials

1. Tnemec
 - a. Fittings, Valves & Pumps \geq 1/2-inch diameter; Pipe \geq 10-inch diameter;
 - i. Primer: Series 91-H20 (6 to 8 Mil DFT)
 - ii. Finish Coat: Series 22 Epoxoline (16 to 20 Mil DFT)
 - b. Fittings, Valves & Pumps \geq 4-inch diameter; Pipe \geq 18-inch diameter;
 - i. Primer: Series N140 Pota-Pox Plus or Series 141 Potapox 80 (6 to 8 Mil DFT)
 - ii. Finish Coat: Series N140 Pota-Pox Plus or Series 141 Potapox 80 (6 to 8 Mil DFT)

Part 3 – Execution

Surface Preparation

Ferrous Metal – SSPC SP1 followed by SP10 Near White Blast. Surface profile shall be 2.0 Mil, minimum.

Ductile Iron – SSPC SP1 followed by NAPF 500-03-04/05 Grey White Blast or SP10 Grey White Blast. Surface profile shall be 2.0 Mil, minimum.

9.91.33.05 - System 6: Buried Steel Structure

[CSI 09 97 13 30]

Part 2 – Products

Materials

Interior Lining

1. Option 1: Liquid Epoxy
 - a. AWWA C210
2. Option 2: Powder Coat or Fusion Bonded Epoxy
 - a. 3M Scotchkote - fusion bonded epoxy (12 to 16 Mil DFT), or
 - b. AWWA C213

Exterior Coating

Exterior coating for steel structure.

1. One coat, coal tar epoxy coating with a greater than or equal to 16 mil dry film thickness.
2. Alternative coating systems will be considered.

Part 3 - Execution

Surface Preparation

1. SSPC-SP10 Near white blast cleaning, or
2. Per preparation methods described in the applicable AWWA product standard.

Application

All linings and coatings must be shop applied. Field applied tape systems may be allowed at fittings and valves at the discretion of the Engineer.

Repair

Repair any linings or coating where damage has occurred. Follow the manufacturer's instructions.

Division 13

Special Construction

13.00 GENERAL

This division covers that work necessary for supplying, fabricating and installing all furnishings and accessories as described in these specifications and as shown on the Plans.

Sections in these specifications titled “*Common Work for . . .*” shall apply to all following subsections whether directly referenced or not.

13.05 Common Work for Special Construction

[CSI 13 05 00]

Part 1 - General

Submittals

Prefabricated building.

Related Sections

- Division 9 Finishes

13.30 SPECIAL STRUCTURES

[CSI 13 30 00]

13.32 Water Utility Transmission and Distribution

[CSI 33 14 00]

13.32.43 Packaged Pumping Systems for Water Utility Service

[CSI 33 14 43]

Part 1 - General

Summary

The work shall include designing and supplying the structure, including hatches, stairs, and ladders; pumping equipment; internal piping; controls; and appurtenances within and adjacent to the pump station as a complete, functional, pre-designed packaged pump station as shown on the drawings and specified herein and delivered to the project site just west of 13403 196th Avenue East, Bonney Lake, WA 98391.

All equipment and materials utilized in the system shall be, unless otherwise noted, the products of reputable, experienced manufacturers with at least five (5) years' experience in the manufacture of similar equipment. Similar items in the system shall be the products of the same manufacturer/supplier. All equipment shall be of industrial grade and of standard construction, and shall be capable of long, reliable, trouble-free service. All equipment and components shall be UL listed. The entire station shall also be UL listed as a prefabricated

unit under 'QCZJ – Packaged Pumping Systems'. The pump station's UL label shall be affixed to the underside of the main entrance hatch.

The station shall be as manufactured by USEMCO, Inc.; Dakota Pump, Inc.; Precision Pumping Systems; or approved equal.

The pump station shall be completely assembled in the factory by the Contractor. All components and equipment shall be pre-wired and tested.

All penetrations of the capsule shall be covered with protective caps, to protect against damage, and the entry of debris into the piping/ electrical systems, during shipping.

References

- ANSI American National Standards Institute
- ASTM American Society for Testing and Materials
- HI Hydraulic Institute 1.1 – 1.6, 9.1 – 9.8, 14.6
- NSF National Sanitation Foundation
- UL Underwriters' Laboratories, Inc.

General Features

The chamber shall be of welded steel construction, complete with exterior bracing as necessary to support the weight of the structure, internal and external loads and soil. The structure is anticipated to be buried under approximately three (3) feet of soil and is to be designed based on the following parameters.

Design Code	IBC 2018
Seismic Design Category	D
Risk Category	IV
Roof Snow Load	25 psf
Roof live load	100 psf
Vehicle surcharge	HS-20 (250 psf)
Soil Load	345 psf
Snow Importance Factor (Is)	1.2
Seismic Importance factor (Ie)	1.5
Seismic design value Sds, Sd1	0.966g, 0.416g
Passive earth pressure	283 psf per foot
Active earth pressure	31 psf per foot
At rest earth pressure	49 psf per ft
Allowable static soil bearing pressure (1/3 increase for dynamic loads)	5,000 psf
Soil profile type	C Hard Soil
Friction coefficient	0.4

The chamber shall be complete with two sumps. Each sump shall be a minimum of 18 inches in diameter by 16 inches deep, and shall have mounting brackets installed for the sump pump. A deeper sump is preferable, but not mandatory.

The capsule walkway areas and open floor space shall be covered with industrial non-conducting safety matting. The mat shall be a heavy duty, 1/2 inch minimum thickness rubber blend with fiber reinforcement of open slot design with a ribbed safety pattern to promote sure footing. The underside of the safety mat shall also be ribbed to permit aeration and drainage. The safety mat shall not be glued to the floor surface and shall be easily removable for cleaning.

The pumps that are to be provided and installed by the Contractor under this contract are specified in detail herein (see Part 2 – Products, Pumps). The 950/1010 pump station shall be designed by the Pump Station Fabricator to contain a total of six (6) pumps. Pump 1 shall be selected to meet low demand flows. Pumps 2, 3, and 4 shall provide flow up to the peak hour demand. Pumps 5 and 6 shall be high-capacity pumps to provide fire flow/high demands in excess of peak hour demand. The pump station shall have adequate space for all six pumps and associated appurtenances and the pumps shall be located at a height to facilitate easy maintenance.

The mechanical equipment, including but not limited to, the pumps (and integral motors), valves, check valves, fittings, couplings and piping, shall be arranged, located, sized and flexibly connected for easy maintenance and to maximize open spaces in the pump station. The components shall be symmetrically placed with similar components installed in a like manner. Couplings or flanged coupling adapters (FCAs) shall be used to allow for easy installation and removal of the pump station components. All components within the pump station shall be easily removed from the system by using an adequate number of FCAs or couplings.

Pipe supports shall be provided for each header. The supports shall provide adequate vertical, lateral longitudinal (transverse) support.

No galvanized piping or fittings shall be used.

All auxiliary pieces of equipment (exhaust fans, sump pumps, heaters, and dehumidifiers) shall have a redundant unit installed and ready for operation.

Equipment and electrical gear, including but not limited to the LED lights, the convenience outlets, the heaters, the dehumidifiers and the exhaust fans shall all be symmetrically placed throughout the pump station in locations that allow for easy maintenance and adjustment.

Each pump shall have its own motor control center located externally to the pump station in a building provided by others.

Submittals

The booster pump station structural design, shop drawings, specifications and structural calculations must be stamped by a Professional Engineer, licensing as required by the governing agencies and must be submitted to the Owner for review and approval prior to fabrication. Shop drawings shall clearly indicate all shop fabrication, and erection details.

Contractor-initiated changes shall be specifically noted on the shop drawings and be submitted in writing to the Engineer for approval prior to fabrication or construction. Details of all welded joints shall be submitted for approval.

Submittals shall meet the requirements of Division 1.33.

- System schematic diagrams with all components indicated.
- Technical data sheets for all components, including but not limited to:
 - Steel pipe and fittings
 - Isolation valves
 - Check valves
 - Control valves
 - Sensors and gauges
 - Ventilation blower
 - Heater
 - Dehumidifier
 - Stairs
 - Ladders
 - Lights
 - Hose bibs
 - Corp stops
 - Support pad dimensional criteria
 - Variable Frequency Drives
 - Motor Control Center
 - Pump 1 Motor Starter Panel
 - Blower Control Panel
 - Ventilation Control Panel
 - Instrumentation and Sensors
- Dimensional drawings of the Unit with all devices and equipment indicated. Include weight of the assembled Unit.
- Control panel schematics.
- Interior and exterior control panel layout drawings.
- Description of pump control functions.
- Calculations of package station headloss.

Delivery, Storage, and Handling

The completed pump station shall be delivered to the site location outlined in Division 1 in coordination with the Owner and the Installation Contractor. The Contractor shall store the completed pump station at a location of their choosing until the Owner and Installation Contractor are ready for delivery. The Contractor shall permit the Owner access to the completed pump station for inspection at the Owner's request. The Contractor is responsible for the pump station until it has been delivered to the project site.

Warranty

The Contractor shall guarantee the Unit to be free of defects in design, materials and workmanship for a period of 18 months following the date of acceptance, by formal action of the Owner. The date of acceptance by the Owner will occur once start up and testing of the in-place pump station and the pump station is put into normal operation by the Owner.

Warranty and guarantees by suppliers of various components in lieu of a single source responsibility by the manufacturer will not be accepted. The Contractor shall be solely responsible for the guarantee of the packaged booster pump station system and all components that make up the packaged booster pump station system. In addition, the Contractor agrees to give instructional information to the station's operation and maintenance for the useable life of the station free of any charges.

Part 2 - Products

Manufacturer

The Contractor shall be a Booster Pump System Manufacturer who specializes in the sales, maintenance, and repair of pumps and pumping systems. The Contractor shall have been continuously engaged in business for at least seven years.

The station shall be as manufactured by USEMCO, Inc.; Dakota Pump, Inc.; Precision Pumping Systems; or approved equal.

Components

The package pump unit shall be installed on a cast-in-place concrete support pad by others. Contractor shall specify length and width dimensions of the pad, including mounting points and sizes.

Equipment Chamber

The equipment chamber shall be a vertical elliptical shaped chamber with a minimum nominal inside width of 12 feet, no more than 14 feet; an inside height of 10 feet, no more than 11 feet; and an overall length of 38 feet, no more than 39 feet; as shown on the plans.

The equipment chamber shall be fabricated of structural grade steel plate that meets or exceeds the requirement for ASTM-A36. The chamber vertical wall and top shall be a minimum 1/4" thick and the bottom shall be a minimum of 3/8" thick. The equipment chamber shall be reinforced as required to adequately support all loads. It shall be the responsibility of the Contractor to determine the structural requirements of the equipment chamber based on the external loads specified on the plans and in these Specifications.

Structural calculations shall be provided, certified and stamped by a professional engineer, to verify the structural integrity.

The plate forming the top and bottom of the equipment chamber shall be assembled and welded to the vertical wall to form a Tee joint which shall be continuously welded to form a watertight seal. All watertight welds shall be factory tested with a dye penetrant to assure the watertight integrity of the weld system.

Lifting eyes incorporated within the top reinforcements shall be provided on the top of the chamber to facilitate lifting and handling the equipment chamber. Lifting eyes shall also be provided inside the equipment chamber located to facilitate the removal and installation of each pump at an adequate height to permit a hoist to be used for service work.

Chamber shall be sized to accommodate adequate access to each pump, valves, and other appurtenances. All electrical code clearances shall be satisfied.

Entrance Manway with Walk Down Staircase

The equipment chamber entrance manway shall be a prefabricated metal, rectangular roof scuttle of aluminum and shall be insulated with glass fiber 1 inch thick, fully covered and protected by a watertight metal liner. The cover shall be formed with a 3 1/2 inch flange with holes provided for securing to angle framing on top of the equipment chamber. This connection shall be sealed with a suitable gasket sealing compound to insure a watertight seal.

The cover shall be completely assembled with heavy pintle hinges, compression spring operators, enclosed in telescopic tubes and a full perimeter, foam draft seal. The cover shall be equipped with an automatic hold open arm complete with red vinyl grip handle to permit easy, one hand release. When the cover is in the full open position, the hold open arm will engage a lock open device to prevent accidental closing of the cover.

All cover hardware shall be stainless steel with the exception of the entrance lock which shall be brass. The entrance manway shall be provided with a flush mounted keyed entry with pin and tumbler type dead bolt lock with inside safety release. The entry lock shall be flush mounted in the cover in a position to be protected from the elements by the cover skirt.

An entrance staircase shall be provided which is built to conform to OSHA specifications and be constructed to meet the requirements of WAC 296-24-735 through WAC 296-24-81011 and WAC 296-155-245. The staircase shall be an alternating tread style with the maximum angle of the staircase to the floor shall be 50 degrees. The stairs shall extend to within 2" from top of entrance manway. A handrail shall be provided on each side of the staircase inside the station chamber. Minimum headroom above each step shall be 84". Staircase shall have a minimum of 36" of free space in front of bottom step and shall not interfere with access to the equipment inside the station.

Entrance Manway with Ladder

The equipment chamber entrance manway shall be a prefabricated metal, rectangular roof scuttle of aluminum and shall be insulated with glass fiber 1 inch thick, fully covered and protected by a watertight metal liner. Manway shall be sized large enough to allow for removal of the largest component from the chamber. The cover shall be formed with a 3 1/2 inch flange with holes provided for securing to angle framing on top of the equipment

chamber. This connection shall be sealed with a suitable gasket sealing compound to insure a watertight seal.

The cover shall be completely assembled with heavy pintle hinges, compression spring operators, enclosed in telescopic tubes and a full perimeter, foam draft seal. The cover shall be equipped with an automatic hold open arm complete with red vinyl grip handle to permit easy, one hand release. When the cover is in the full open position, the hold open arm will engage a lock open device to prevent accidental closing of the cover.

All cover hardware shall be stainless steel with the exception of the entrance lock, which shall be brass. The entrance manway shall be provided with a flush mounted-keyed entry with pin and tumbler type dead bolt lock with inside safety release. The entry lock shall be flush mounted in the cover in a position to be protected from the elements by the cover skirt.

An UL and OSHA approved aluminum ladder shall be provided for access into the equipment chamber. A ladder-up safety post shall also be provided with a telescoping tubular section that locks automatically when fully extended. A release lever shall also be provided to allow the safety post to be returned to its lowered position when the manway cover is closed.

Bridge Crane and Hoist

The Contractor shall provide a bridge crane hoist and trolley system within the station for the purpose of pump and heavy equipment maintenance. The dual rail bridge crane system shall be complete with traveling beam and a manual chain hoist with trolley. The bridge crane shall be sized to lift one and a half times the heaviest item of equipment in the station and a minimum of one-ton capacity. The bridge crane rails shall be welded to the station ceiling. Sufficient clearance shall be provided between the top of the motors and the hoist hook for removal of pumps and motors.

The manual hoist chain shall be manganese steel, case hardened with anti-rust treatment. The trolley shall include steel wheels for use on wide flange steel beams.

Structural Connection for Cathodic Protection

A corrosion protection system will be designed and installed by others after the pump station has been set in place. To facilitate the addition of this corrosion protection system, provide eight (8) welded tabs on the exterior, two (2) per wall face. The tabs shall be located symmetrically, equidistant from the edge of wall and nearest tab, and shall be located at mid-wall-height. Each tab shall be 4"x4" square, minimum 1/4" steel plate, installed so large face is oriented facing up. Fillet weld all round. Install prior to coating and lining system application. Provide coating system equal to station exterior.

Pump Station Coating

See Division 9 for pump station coating requirements.

Pipe and Fittings

Under no circumstance shall the fasteners be of lesser strength or higher corrosive potential than the materials being connected. If dissimilar metals are adjacent (for example: stainless steel flange connecting to ductile iron flange) a dielectric insulation kit shall be used.

Fasteners for pipe and fittings: Per AWWA standards unless otherwise specified. All relevant subsections of AWWA C100, C200, and C500. All bolts and studs shall be long enough so that no less than two threads extend beyond the face of the nut. Non-submerged flange bolts to be ASTM A307 Grade A, zinc plated.

All internal transmission piping and fittings shall be of schedule 40 black, seamless steel pipe and will be manufactured in accordance with the dimensional tolerances and material specifications of the AWWA C-200-17 for steel pipe and steel butt-welded fittings.

All materials used for fabrication of the pipe and appurtenances shall be new and unused.

All piping shall be sized as shown on the plans or of sufficient diameter to keep velocities less than approximately 8 ft/s (exceeding 8 ft/s may be allowed with Engineer Approval). The total maximum headloss through the pump station shall be less than (9) feet (including minor losses and piping friction losses).

The interior of the pipe shall be cleaned and shall have no projections resulting from welding which extend more than 1/16" from the surface of the plate. The exterior of the pipe shall not have projections resulting from welding extending more than 1/8" from the surface of the plate.

All pipe joints in 1/4" or thicker plate shall not be less than two-pass butt welds for manual work. Automatic welding shall not be less than two passes, made from opposite sides of the plate, and all succeeding passes shall be fully fused into the plate and the preceding weld pass.

The Engineer shall reserve the right at any time to call for and witness the making of test specimens by any welder and to observe the physical tests. All welding rod or welding wire shall be approved by the Engineer.

The ends of the pipe shall be beveled for welding.

The terminal ends of the suction and discharge headers, internal to the pump station and future connections, shall be capped with a 150-pound blind flange.

Bends greater than 8" in diameter shall have a lifting eye installed at the balance point of the bend, or two lifting eyes at 3 o'clock and 9 o'clock to facilitate lifting with the bridge crane.

Pipe Coating

See Division 9 for pipe coating requirements.

Compression Couplings

Compression couplings, where shown on the drawings, shall consist of steel sleeves with compression gaskets and followers. Couplings will be bolted style for over 2" and threaded style for 2" and less.

Butterfly Valves

Butterfly valves shall be used as isolation valves in the unit and shall be installed as shown on the plans. The disc of butterfly valves, while in the open position, shall not strike any other valve or other equipment items. Valves shall have flanged connections to the adjacent pipe.

The valve body shall be of cast iron construction with a centering rib to assure accurate positioning. The valve stem shall be of full diameter through the valve body and be isolated from the fluid medium. The valve disc shall be of ductile iron accurately machined for proper contact with the replaceable rubber seating surface.

Butterfly valves shall be Pratt, Bray, or Engineer Approved Equal.

Valves 6 inches and smaller shall be equipped with lever handles and throttling plates.

Valves 8 inches and larger shall be equipped with totally enclosed gear operators with hand wheels.

Silent Check Valves

Each pump discharge piping shall include a wafer or globe style, non-slam check valve, sized as shown on the plans and designed for installation between two Class 150 flanges. The valve body shall be of cast iron construction, bronze plug, seat and guide bushings with stainless steel valve spring and seat retainer. The valve plug shall be guided at both ends by a center shaft integral with the valve plug. Alignment of the center shaft shall be provided through the usage of guide bushings. The check valve shall be designed to prevent water hammer by returning the valve plug to the seat before reversal of flow occurs.

Electric Control Valve Actuators for Pump Discharge

An electric control valve actuator shall be installed on the discharge side of Pumps 5 and 6. The actuator shall be Rotork Model IQT500, 120VAC, 60 Hertz, with Profibus Communication Interface, and Bluetooth option for commissioning and configuration setups, no substitutions.

The actuator shall have an operating time adjustable from 60 to 240 seconds by using an interrupter timer. The actuator shall be housed in a NEMA 6 type enclosure and shall be watertight and double "O" ring sealed.

The actuators supplied shall be a non-intrusive type actuator with commissioning and control configuration using an infra-red setting tool.

The actuators shall be capable of guaranteed valve seating/unseating at all expected differential pressures within a margin of safety of 10%. The actuators shall be provided with four extra indication contacts for monitoring valve position, status, valve alarms, and actuator alarms.

The actuators shall be capable of both local and remote electric operation as well as local manual operation by use of a suitable hand wheel. Local manual operation shall override all other operational modes.

The actuators shall be supplied with suitable mounting adaption and drive bushing (machined stem nut) for mounting on the butterfly valve specified in these specifications. Butterfly valve sizes are indicated on the contract drawings.

Pressure Relief and Sustaining Valve

The water pressure relief and sustaining valve, sized as shown on the plans, shall be a hydraulically operated, pilot controlled, diaphragm type globe valve.

The valve shall have a single removable seat and a resilient disc and the valve stem shall be guided at both end by a bearing in the valve cover and an integral bearing in the valve seat.

The valve shall be of cast iron construction, bronze integral trim, flanged or threaded end construction.

The pilot control shall be a direct-acting, adjustable spring loaded, normally open diaphragm valve designed to permit flow when the controlled pressure is less than the spring setting.

The pressure relief valve assembly shall be so designed to hold a set upstream pressure and provide pressure relief for the higher zone.

The smaller pressure relief valve shall be electronically actuated such that the valve can be shut under high flow conditions.

Pressure Gauges

Pressure gauges shall be provided to indicate suction and discharge pressure and shall be wall mounted on a steel plate as near to the pressure source as possible. The gauges shall have 4 1/2 inch minimum diameter faces with molded black phenolic case, turret type with snap ring face mounting. The gauge internal construction shall include phosphor bronze bourdon tube with bronze movement. The gauges shall have 1/4" N.P.T. bottom connections, flexible sensing lines, bronze snubbers and needle valves. Pressure gauges shall be Turck or Equal.

Pressure gauge ranges shall be as follows:

Suction Pressure: 0 to 100 PSI.

Discharge Pressure: 0 to 100 PSI.

Air Outlet and Return Breathers

Exhaust fans in the pump station shall be provided with a breather pipe as shown on the contract plans. The piping shall extend into the pump station and shall be connected to the exhaust fans. All portions of breather piping within the station shall be coated as described in these specifications.

A return breather shall also be provided as shown on the contract plans. The return breather will allow the intake of fresh air into the pump station. The return breather shall be located as far from the exhaust fans as possible to minimize the amount of air short-circuiting and to maximize ambient air turnovers. The return breather piping shall extend into the pump station and shall terminate not greater than 6" from the pump station floor. All portions of the breather piping shall be coated as described in these specifications.

Pumps

Performance Requirements

Power required to operate the pump(s) shall not exceed the motor nameplate horsepower regardless of any flow and head tolerances listed in this specification, unless allowed otherwise in the Pump Motors section.

The design and performance requirements listed for each pump must be met, with no exceptions. Pumps that do not meet all of the conditions will be rejected.

Pump parts in contact with potable water shall be lead free complying with either NSF 61 ANSI 372 tested or NSF 61 Annex G compliant. Submit lead free information with pump submittal information.

Performance Tolerance

Performance range shall adhere to the HI 14.6 (centrifugal and vertical pumps) tolerances stated herein at the specified design point(s). Flow tolerance is measured at the design point head. Head tolerance is measured at the design point flow. Efficiency is evaluated where a straight line drawn from zero flow, zero head, passes through the design point and crosses the actual pump curve.

Grade 1U (0% to +10% Flow, 0% to +6% Head, no less than 0% Efficiency).

Pump 1

The pump shall be of the in-line vertical multi-stage centrifugal design.

Design point of 40 gpm at 126 feet TDH.

Shutoff head no less than 140 ft and no more than 150 ft TDH.

Efficiency at the design point shall be no less than 61 percent.

Maximum NPSHR at design point shall be no more than 9 feet.

Pump 2

The pump shall be of the end suction centrifugal design.

Design head – 132 feet

Design flow - 142 gallons per minute

Maximum NPSHR – 12 feet at design point

Maximum shut-off head - 190 feet.

Minimum shut-off head - 160 feet

Fluid – potable water at 60 degrees Fahrenheit.

Min. pump efficiency at design head - 72 percent

Pump 3

The pump shall be of the end suction centrifugal design.

Design head – 132 feet

Design flow - 258 gallons per minute

Maximum NPSHR – 9 feet at design point

Maximum shut-off head - 150 feet.

Minimum shut-off head - 135 feet

Fluid – potable water at 60 degrees Fahrenheit.

Min. pump efficiency at design head - 76 percent

Pump 4

The pump shall be of the end suction centrifugal design.

Design head – 132 feet

Design flow - 365 gallons per minute

Maximum NPSHR – 14 feet at design point

Maximum shut-off head - 170 feet.

Minimum shut-off head – 160 feet

Fluid – potable water at 60 degrees Fahrenheit.

Min. pump efficiency at design head - 77 percent

Pump 5 and 6

The pumps shall be of the end suction centrifugal design.

Design head – 162 feet

Design flow - 2,300 gallons per minute

Maximum NPSHR – 20 feet at design point

Maximum shut-off head – 225 feet.

Minimum shut-off head - 200 feet

Fluid – potable water at 60 degrees Fahrenheit.

Min. pump efficiency at design head - 85 percent

Submittals

Submittal information shall be provided for each pump capacity.

Product Data:

- A minimum of 5 installations with similarly sized and configured pumps in equivalent fluid applications. Include location, contact name, and number.
- Specifications and data describing all pump parts, pieces, and components. Include information on materials of construction and proposed coating systems.
- Performance curves showing total dynamic head (TDH) in feet, efficiency, 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.
- Additional curves for VFD pumps, curves for speeds at 40 percent, 60 percent, and 80 percent of full speed.
- Provide documentation on assembled pump and motor unit natural frequency. Natural frequency shall not occur within 20 percent of speed above or below the pump's operating speed range of 40 to 100 percent of the rated speed.

- Complete list of all pump system components and accessories to be provided.
- Calculations showing compliance with bearing life and shaft deflection.

Manufacturers

The following manufacturers are pre-approved for use on this project. The bidder may submit another brand for review prior to the bid opening. Follow the procedures under Division 1.33.23 Substitutions Prior to Bid Opening. Accepted brands will be approved through addendum. No substitutions for different pump brands will be accepted after the bid opening.

Centrifugal	
Grundfos or Goulds (Pump 1 only)	Cornell (Pumps 2 – 6)

Components

For pumps in domestic water applications, all wetted pump components, coatings, and lubricants shall be compatible for use in potable drinking water in accordance with U.S. Food and Drug Administration (FDA) or National Sanitation Federation (NSF) rules and regulations.

All pump system components are to come from the pump manufacturer and shall include:

- Motor
- Discharge head or pump casing
- Couplings
- All other necessary appurtenances for complete unit assembly.

End Suction Centrifugal Pumps

Where the pump motor will be controlled by a VFD, all pump components shall be sized and selected for variable speed operation.

Pump casing material to be close grained cast iron. Suction and discharge ports drilled for 125 lb. bolt pattern.

Mount bronze, renewable casing rings in the casing. Casing to have taps for air release and drain.

Impellor to be one-piece cast aluminum-bronze, hydraulically, and statically balanced. Trim impellor at the factory for the specific design conditions.

Seal the pump liquid cavity with a face-type mechanical seal. Provide seal rated for 225 degrees Fahrenheit. Mount seal over the shaft sleeve. Provide one set of spare mechanical seals for each pump.

For fractional-frame pumps provide stainless steel shaft. For larger frame pumps provide carbon steel shaft with bronze shaft sleeve.

Vertical Multistage Centrifugal Pumps

Small Vertical In-Line Multi-Stage Pumps shall have the following features:

1. The pump impellers shall be secured directly to the pump shaft by means of a splined shaft arrangement.
2. The suction/discharge base shall have ANSI Class 250 flange connections.
3. Pump construction
 - a. Suction/discharge base, pump head, motor stool: Cast iron (Class 30). Optional materials for the suction/discharge base and pump head shall be 304 or 316 stainless steel resulting in all wetted parts of stainless steel.
 - b. Impellers, diffuser chambers, outer sleeve: 304 or 316 Stainless Steel or cast aluminum bronze.
 - c. Shaft Steel: 316 or 431 Stainless Steel
 - d. Impeller wear rings: 304 Stainless Steel or Teflon
 - e. Shaft journals and chamber bearings: Silicon Carbide, Aluminum Oxide Ceramic, bronze or tungsten carbide
 - f. O-rings: EPDM
4. Shaft couplings for motor flange sizes 184TC and smaller shall be made of cast iron or sintered steel. Shaft couplings for motor flange sizes larger than 184TC shall be made of ductile iron (ASTM 60-40-18).
5. The shaft seal shall be a balanced O-ring cartridge type with the following features:
 - a. Collar, Drivers, Spring: 316 Stainless Steel
 - b. Shaft Sleeve, Gland Plate: 316 Stainless Steel
 - c. Stationary Ring: Silicon carbide – graphite embedded, or tungsten carbide
 - d. Rotating Ring: Silicon carbide – graphite embedded, tungsten carbide, or carbon graphite.
 - e. O-rings: EPDM
6. Shaft seal replacement shall be possible without removal of any pump components other than the coupling guard, shaft coupling, and motor. The entire cartridge shaft seal shall be removable as a one-piece component.

Accessories

Provide removable guards to protect personnel from rotating components. Guards to meet the minimum requirements of WAC 296-806-20042.

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. The nameplate shall include, at a minimum, the following information:

- Pump Manufacturer
- Pump Model Number

- Pump Serial Number
- Impeller Number
- Impeller Trim
- Design TDH (feet)
- Design Flow (gpm)
- Supplier Name and Phone Number
- Date of Manufacture

Pump Motors

General

Submittals

Submittal information shall be provided for each individual motor.

Product Data:

Specifications and data describing all motor parts, pieces, and components. Include information on materials of construction and proposed coating systems.

Motor data including type, torque, RPM, no-load current, full-load amps, service and power factors, and motor efficiency at full-load.

Where variable speed drive motor is required, provided performance curves and motor efficiency at the following percentages of full load: 25 percent to 100 percent, by 25 percent increments.

Complete list of all motor components and accessories to be provided. All motor system components are to come from the pump manufacturer.

Bearing life (L10) for ball and roller bearings. Calculations supporting L10 of no less than 40,000 hours.

Shop Drawings:

Detailed dimensional drawings showing outline dimensions, lengths, overall sizes, materials, and weights for each motor and associated accessories.

Provide catalog data for each motor showing the following information:

- Horsepower vs. Load
- Power factor vs. Load

Closeout Submittals: Provide the following submittals prior to project closeout:

- Operations and Maintenance Manual
- Manufacturer signed warranties with serial numbers.

Quality Assurance

Ensure that motors selected are locally serviceable and replacement parts are readily available.

Motors shall be dynamically balanced at the factory and shall have maximum vibration amplitude of 0.001-inch peak-to-peak.

Delivery, Storage, and Handling

Motors shall be delivered, stored, and handled in accordance with manufacturer recommendations. Store in a dry, enclosed environment and in an upright position.

Design Requirements

Motors shall operate on a 3-phase, 460 volt, 60-cycle power supply.

Maximum speed of 3,600 revolutions per minute (rpm).

Provide a premium efficiency motor with efficiency at design point not less than shown in Table C405.8(1) or C405.8(2), as applicable, of the Washington State Energy Code (WAC 51-11C-40508), current edition. Efficiency as determined by IEEE Standard 112, Test Method B. Motors shall be designed for a continuous cycle.

Motors shall be inverter duty rated for Variable Frequency Drive applications per NEMA MG1 Part 31.

Motors shall be sized such that power draw in the normal operating range of the pump shall not exceed the nameplate size. Power draw shall not encroach into the service factor. Motor size selection shall include all losses, including motor and pump bearings.

Thrust bearings: Oil-bath lubricated with a designed life not less than 40,000 hours. Upthrust protection of 30 percent of the down thrust or as required to support pump upthrust at startup, whichever is greater, shall be provided in the bearings.

Motors shall have TEFC enclosures.

Maintenance

Provide any special tools required for motor maintenance. Provide enough lubricant for one service change.

Accessories

All motors are to include an engraved non-corrosive metal nameplate on the exterior of the motor (duplicate shipped separately if submersible), readily accessible without requiring any disassembly. The nameplate shall include, at a minimum, the following information. Common abbreviations shown in brackets [].

- Manufacturer
- Motor type [TYPE]
- Model Number [MN, MODEL, MOD.NO]
- Serial Number [SN, SERIAL, SER NO]

- Frame size [FRAME]
- NEMA design letter [DESIGN]
- Insulation class or rated temperature rise [INS, CLASS]
- Nominal Power (hp) [HP, OUTPUT]
- Time rating [RATING]
- Locked rotor kVA code [CODE]
- Service Factor [SF]
- Voltage [VOLTS]
- Phase [PH]
- Frequency (Hz) [CYCLES]
- Full load amps [FLA]
- Full load speed (rpm) [SPEED, FL RPM]
- Nominal Efficiency (%) [NEMA NOM EFF]
- Date of Manufacture
- Special ratings (Inverter duty, NFPA, Class 1 Division 1, UL, etc.)

Connection between motor and head shaft shall be through manufacturer's recommended coupling, complete with non-release protection (if non-reversing ratchet is not specified), to prevent pump shaft from unscrewing in the event of phase reversal. Non-submersible motors shall have lifting lugs.

Provide motor with one positive temperature coefficient (PTC) thermistor per phase embedded in the motor winding for a total of three (3) thermistors. The PTC thermistors shall be wired in series to a clearly labeled termination point for connection to the motor control electronics for monitoring the temperature of the motor. A wiring diagram of this arrangement shall be provided with the submittal.

High speed (>2,500 rpm) motors larger than 10 hp shall include a steady bushing.

Finishes

Pump motors shall be furnished with a prime coat or finished epoxy coat of the manufacturer's standard finish. Stainless steel casings need not be coated. Motors with only a primer coating shall be finish coated in the field with a product suitable for the environment and the motor temperature range, submit to Engineer for approval.

Source Quality Control

Factory Pump Performance Testing and Certification

Factory testing curves and data on each pump must be provided prior to pump leaving the factory. Variations between factory tests and previously submitted catalog curves may be

cause for rejection. Factory testing of the pump may use a dynamometer or calibrated shop motor.

Perform a performance test as described in the latest edition of Hydraulic Institute's (HI) Pump Tests (ANSI/HI 14.6 Centrifugal and Vertical, ANSI/HI 11.6 Submersible), with results submitted to the Engineer for written approval for each pump prior to shipment. Test pumps at the factory to HI standards, except as modified below.

- Test speed must be within 20 percent of the rated speed unless prior written approval is given by the Owner. Approval is not guaranteed.
- 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.
- HI 14.6 Appendix K, 11.6.10: Model tests are not allowed unless prior approval is given by Owner. Supplier shall submit a written request to perform a model test with procedures outlined for Owner's review.
- Provide a certified data sheet and performance curve for each pump similar to HI 14.6 Appendix H pump test summary of information. At a minimum provide:
 - Information per HI standards.
 - TDH (ft) vs. Flow (gpm)
 - Power (hp) vs. Flow (gpm)
 - NPSHR (ft) vs. Flow (gpm) (catalog data is acceptable)
 - Motor Input Power
 - Hydraulic Efficiency (%) vs. Flow (gpm) (where applicable)

Perform factory vibration testing as follows:

- Take vibration readings under normal operating conditions at the design point.
- If a throttled valve is used to adjust the operational point during vibration testing, the valve must be no closer than 20 times the pipe diameter from the pump and separated from the pump by at least one flexible pipe joint.
- For variable speed pumps, take readings at full speed and two reduced speeds as directed by the Owner. Do not test below the manufacturer's lowest allowed speed.
- Read vibrations at the locations described in HI 9.6.4.2.3. In general, the reading locations shall be at:
 - The middle of each bearing housing of between bearing pumps.
 - Near the outer casing bearing of end suction pumps.
 - Near the top of the motor support flange for vertical motors.

- Read vibrations in the three orthogonal planes, with the maximum reading governing the results. If the vibration tests fail, the pump manufacturer and/or Contractor shall modify the equipment and/or installation and retest until the standards are met. Submit the vibration test results to the Owner. The Contractor or pump manufacturer's representative shall provide proper, calibrated instrumentation to verify completed unit vibration.
- Factory vibration testing shall be performed by a Level 1 certified Vibration Analysis Tester. The results of the test shall be reviewed by a Level 3 certified Vibration Analysis Tester. Certification shall be current and from one of the following: Mobius Institute, Vibration Institute, Technical Associates of Charlotte.

Graphs must be submitted and approved by Engineer prior to shipment of pumps.

Part 3 - Execution

Electrical Control System

General

Refer to Divisions 16 and 17 for electrical and automatic control system requirements.

Part 3 - Execution

Pumps

Preparation

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.

Installation/Construction

Install pump units in accordance with pump manufacturer's specifications and direction. Installation shall be supervised and approved by manufacturer's representative prior to operating or field testing units.

Adjust pump assemblies so that driving units are properly aligned, plumb, and level with the driven units and all interconnecting shafts and couplings. Flexible couplings shall not be used to compensate for any misalignment.

Connect suction and discharge piping to the pump in a manner which prevents strain on pump flanges.

Field Quality Control

See Division 1 Scheduling of Work for scheduling and notification requirements.

A qualified and authorized representative of the pump manufacturer shall conduct and/or supervise the field testing. Prior to acceptance of installed pumps, manufacturer's representative shall demonstrate proper operation of pumps at capacities stated. Upon

completion of pump installation and testing, manufacturer's representative shall provide written certification that equipment is installed correctly and fully warranted.

Contractor shall be responsible for calibration, startup, and initial performance to meet specifications herein. A field test shall be made to give an indication of the performance of the new pump when it is operating under actual field conditions and to establish the acceptance of the pump furnished and installed. The field test shall be performed in the presence of the Engineer after the piping and controls have been installed.

A performance test similar to those described in the latest edition of Hydraulic Institute's (HI) Pump Tests (ANSI/HI 14.6 centrifugal and vertical, ANSI/HI 11.6 Submersible) shall be performed, submitted to the Engineer and approved for each pump.

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.

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. At that time, the following data shall be collected for each pump:

- TDH vs. Flow at a minimum of three points which include: Shutoff head (unless pressure is deemed excessive by the Engineer), fully open to system, and approximately 50 percent design flow with throttled discharge valve. Additional points may be required at the discretion of the Engineer.
- Overall Efficiency
- Vibration readings shall be taken at the locations described in Hydraulics Institute standard 9.6.4.3.2. Vibrations shall be read in the three orthogonal planes, with the maximum reading governing the results. If the vibration tests fail, the manufacturer and/or Contractor shall modify the equipment and/or installation and retest until the standards are met. Submit three copies of the vibration test results to the Engineer. The manufacturer's representative shall provide proper, calibrated instrumentation to verify maximum completed unit vibration amplitude.

Maximum allowable completed unit vibration amplitude (pump and motor installed) shall be per the current Hydraulic Institute Standards, Section 9.6.4.4 or 11.6.8.

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.

Repair

Repair and retest units failing any field test. If unit fails second field test, unit will be rejected and Contractor shall furnish a unit that will perform as specified.

Welding

All welding shall be in accordance with standard AWS practices, with proper fillet section and continuity to assure a sound, watertight structure. All welds shall be sound and free from embedded scale or slag, shall have tensile strength across the weld not less than that of the thinner of the connected sections, and shall be watertight. Butt welds shall be used for all welded joints in line pipe assemblies. Fillet welds shall be used for flange attachment in accordance with AWWA C207. All welds in contact with soil or water shall be tested with a dye penetrant to assure the watertight integrity of the weld system. All pipe and fittings shall be welded by welders certified for ASME type IX pipe welding.

All welding shall be completed prior to blasting or coating of the pump station. All mounting brackets, padeyes, structural steel, piping, and other miscellaneous components shall be installed prior to coating. No welding after the pump station has been coated will be allowed.

Pump Motors

Examination

Contractor shall determine if special lifting equipment is necessary for installation of the motors.

Installation/Construction

Install units in accordance with manufacturer's specifications and direction.

Field Quality Control

Installation shall be supervised and approved by pump manufacturer's representative prior to operating or field testing units. A field test shall be conducted and/or supervised by the pump or motor manufacturer's representative after the piping and controls have been installed. Upon completion of installation and testing, manufacturer's representative shall provide written certification that equipment is fully warranted installed.

Contractor shall be responsible for calibration, startup, and initial performance to meet specifications herein. A field test shall be made to give an indication of the performance of the new motor when it is operating under actual field conditions and to establish the acceptance of the motor furnished and installed. The field test shall be observed by the Engineer after the piping and controls have been installed. Testing shall be completed in accordance with the requirements provided above.

The Contractor shall provide calibrated and certified measuring devices to measure voltage, current, and power factor for each pump motor after they have been installed. The manufacturer's representative shall provide proper, calibrated instrumentation to verify maximum completed unit vibration amplitude.

The following data shall be collected for each motor:

- Motor current (amp) draw vs. Flow.
- Vibration vs. Speed.

Repair and retest units failing field test. If unit fails second field test, unit will be rejected, and Contractor shall furnish a unit that will perform as specified.

Division 16

Electrical

16.00 GENERAL

The Contractor shall provide all labor, material, tools, equipment and services required to complete the furnishing, installation, wiring, connection, calibration, adjustment, testing and operation of all electrical equipment, devices and components as indicated and implied by the plans and specifications.

Sections in these specifications titled “*Common Work for . . .*” shall apply to all following sections whether directly referenced or not.

16.05 Common Work for Electrical

[CSI 26 05 00]

Part 1 - General

Summary

Plans are diagrammatic and indicate general arrangements of systems and equipment, except when specifically, dimensioned or detailed. The intention of the plans is to show size, capacity, approximated location, direction and general relationship of one work phase to another, but not exact detail or arrangement.

Regulatory Requirements

The Contractor shall coordinate and provide all permits, licenses, approvals, inspections by the authority having jurisdiction and other arrangements for work on this project and all fees shall be paid for by the Contractor. The Contractor shall include these fees in the bid price.

Related Sections

See the following sections for items that may be provided and/or installed with other electrical equipment.

- Division 13.32.43 Packaged Pumping Systems for Water Utility Service
- Division 17 Automatic Control

Codes and Standards

Provide all electrical work in accordance with latest edition of National Electrical Code, National Electrical Safety Code, Washington State Electrical Code, and local ordinances. If any conflict occurs between government adopted code rules and these specifications, the codes are to govern. All electrical products shall bear a label from a certified testing laboratory recognized by the State of Washington. Recognized labels in the State of Washington are UL, ETL, and CSA-US.

Definitions

Dry Locations: All those indoor areas which do not fall within the definitions below for wet, damp, or corrosive locations and which are not otherwise designated on the Plans.

Wet Locations: All locations exposed to the weather, whether under a roof or not, unless otherwise designated on the Plans.

Damp Locations: All spaces wholly or partially underground, or having a wall or ceiling forming part of a channel or tank unless otherwise designated on the Plans.

Corrosive Locations: Areas where chlorine gas under pressure, sulfuric acid, or liquid polymer are stored or processed. These areas are identified on the Plans.

The words “plans” and “drawings” are used interchangeably in this specification and in all cases shall be interpreted to mean “Plans”.

The word “provide” shall be interpreted to mean furnish and install.

Design Requirements

Unless otherwise noted, provide enclosures as follows:

1. Class 1, Division 1 and 2 Locations: NEMA Type 7
2. Indoors Unclassified Locations: NEMA Type 12
3. Corrosive Locations: NEMA Type 4X
4. Outdoors and/or Wet Locations: NEMA Type 4X
5. Electrical Rooms: NEMA Type 1

Submittals

Provide submittals of each item specified in this division to engineer for approval in accordance with Division 1 of these specifications. Submittals for motor control centers, motor control panels, control panels, instrumentation panels, and pump control panels shall include at a minimum: a wiring diagram or connection schematic, and an interconnection diagram.

Wiring Diagram or Connection Schematic

1. This plan or plans shall include all of the devices in a system and show their physical relationship to each other including terminals and interconnecting wiring in assembly. This diagram shall be in a form showing interconnecting wiring only by terminal designations (wireless diagram).

Interconnection Diagram

1. This diagram shall show all external connections between terminals of equipment and outside points, such as motors and auxiliary devices. References shall be shown to all connection diagrams which interface to the interconnection diagrams. Interconnection diagrams shall be of the continuous line type. Bundled wires shall be shown on a single line with the direction of entry/exit of the individual wires clearly shown. All devices and equipment shall be identified. Terminal blocks shall be shown as actually installed and identified in the equipment complete with individual terminal identification. All jumpers, shielding and grounding termination details not shown on the equipment connection diagrams shall be shown on the interconnection diagrams. Spare wires and cables shall be shown.

Submittal information shall be provided to the Owner for the following items:

1. Motor Control Center
2. Solid State Reduced Voltage Starters (SSRVS)
3. Variable Frequency Drives
4. Power Factor Correction Capacitors
5. Distribution Transformers
6. Branch Circuit Panelboard
7. Circuit Breakers
8. Conduit and Fittings
9. Outlet and Junction Boxes
10. Wire and Cables
11. Switches and Receptacles
12. Light Fixtures
13. Other Electrical Components listed in this Division and/or required by the Engineer.

Part 2 - Products

Source Quality Control

Provide adequate space and fit for the electrical installation, including, but not limited to, determination of access-ways and doorways, shipping sections, wall and floor space, and space occupied by mechanical equipment. Provide electrical equipment that fits in the areas shown on the Plans. All equipment shall be readily accessible for maintenance, shall have electrical clearances in accordance with National Electric Code (NEC) and shall be installed in locations which will provide adequate cooling.

Do not use equipment exceeding dimensions indicated or equipment or arrangements that reduce required clearances or exceed specified maximum dimensions unless approved by the Engineer.

Identification of Listed Products

Electrical equipment and materials shall be listed for the purpose for which they are to be used, by an independent testing laboratory. When a product is not available with a testing laboratory listing for the purpose for which it is to serve, the inspection authority may require the product to undergo a special inspection at the manufacturer's place of assembly. All costs and expenses incurred for such inspections shall be included in the original contract price.

Materials

Use equipment, materials and wiring methods suitable for the types of locations in which they will be located, as defined in Definitions above.

All materials and equipment specified herein shall, within the scope of UL Examination Services, be approved by the Underwriter's Laboratories for the purpose for which they are used and shall bear the UL label.

Components

Fasteners for securing equipment to walls, floors, and the like shall be either hot-dip galvanized after fabrication or stainless steel. Provide stainless steel fasteners in corrosive locations. When fastening to existing walls, floors, and the like, provide capsule anchors, not expansion shields. Size capsule anchors to meet load requirements. Minimum size capsule anchor bolt is $\frac{3}{8}$ -inch.

Accessories

Wire Identification

1. Identify each wire or cable at each termination and in each pull-box using numbered and lettered wire markers. All electrically common conductors shall have the same number. Each electrically different conductor shall be uniquely numbered. Identify panelboard circuits using the panelboard identification and circuit number. Identify motor control circuits using the equipment identification number assigned to the control unit by the motor control center manufacturer and the motor control unit terminal number. Identify other circuits as approved by the Engineer. Identify each wire or cable in each pull-box with plastic sleeves having permanent markings. Conductors between terminals of different numbers shall have both terminal numbers shown at each conductor end. The terminal number closest to the end of the wire shall be the same as the terminal number.

Finishes

Refer to each electrical equipment section of these specifications for painting requirements of equipment enclosures.

Part 3 - Execution

Installation

General

1. Complete the wiring, connection, adjustment, calibration, testing and operation of mechanical equipment having electrical motors and/or built-in or furnished electrical components in accordance with electrical code, UL listing requirements and manufacturer's instructions. Install electrical components that are furnished with mechanical equipment.
2. Provide the size, type and rating of motor control devices, equipment and wiring necessary to match the ratings of motors furnished with mechanical equipment.
3. Complete the procurement, installation, wiring, connection, calibration, adjustment, testing and operation of all electrical devices, components accessories and equipment which is not shown or specified but which is nonetheless required to make the systems shown and specified properly functional.

Workmanship

1. Assign a qualified representative who shall supervise the electrical construction work from beginning to completion and final acceptance.
2. Provide all labor using qualified craftsmen, who have had experience on similar projects.
3. Ensure that all equipment and materials fit properly in their installations.

Field Services

1. Provide field services of qualified technicians to supervise and check out the installation of the equipment, to supervise and check out interconnecting wiring, to conduct start-up and operation of the equipment, and to correct any problems which occur during testing and start-up.

Installing Equipment

1. Provide the required inserts, bolts and anchors, and securely attach all equipment and materials to their supports.
2. Install all floor-mounted equipment on 3½-inch high reinforced concrete pads.
3. Install all equipment and junction boxes to permit easy access for normal maintenance.

Cutting, Drilling, and Welding

1. Provide any cutting, drilling, and welding that is required for the electrical construction work.
2. Structural members shall not be cut or drilled, except when approved by the Engineer. Use a core drill wherever it is necessary to drill through concrete or masonry. Perform patch work with the same materials as the surrounding area and finish to match.

Metal Panels

1. Mount all metal panels, which are mounted on, or abutting concrete walls in damp locations or any outside walls ¼-inch from the wall and paint the back side of the panels with a high build epoxy primer with the exception of stainless-steel panels. Film thickness shall be 10 Mils minimum.

Load Balance

1. Balance electrical load between phases as nearly as possible on panelboards, motor control centers, and other equipment where balancing is required.
2. When loads must be reconnected to different circuits to balance phase loads, maintain accurate record of changes made, and provide circuit directory that lists final circuit arrangement.

Field Quality Control

Minor Deviations

1. The electrical plans are diagrammatic in nature and the location of devices, fixtures, and equipment is approximate unless dimensioned. On the basis of this, the right is reserved by the owner to provide for minor adjustments and deviations from the locations shown

on the Plans without any extra cost. Deviations from the Plans and/or specifications required by code shall also be done, subsequent to Owner's approval, without extra cost.

2. Plans indicate the general location and number of the electrical equipment items. When raceway, boxes, and ground connections are shown, they are shown diagrammatically only and indicate the general character and approximate location. Layout does not necessarily show the total number of raceways or boxes for the circuits required. Furnish, install, and place in satisfactory condition all raceways, boxes, conductors, and connections, and all of the materials required for the electrical systems shown or noted in the contract documents complete, fully operational, and fully tested upon the completion of the project.

Project Record Plans

1. A set of Plans shall be maintained at the job site showing any deviations in the electrical systems from the original design. A set of electrical Plans, marked in red to indicate the routing of concealed conduit runs and any deviations from the original design, shall be submitted to the Engineer for review at the completion of the project prior to final acceptance.
2. After testing and acceptance of the project the Contractor shall furnish in the O&M manuals an accurate connection schematic and interconnection diagram for every service entrance panel, pump control panel, motor control center, and instrumentation panel provided this project.

Cleanup and Equipment Protection

Equipment Protection

1. Exercise care at all times after installation of equipment, motor control centers, control panels, etc., to keep out foreign matter, dust debris, and moisture. Use protective sheet metal covers, canvas, heat lamps, etc., as needed to ensure equipment protection.

Cleaning Equipment

1. Thoroughly clean all soiled surfaces of installed equipment and materials upon completion of the project. Clean out and vacuum all construction debris from the bottom of all equipment enclosures.

Painting

1. Repaint any electrical equipment or materials scratched or marred in shipment or installation, using paint furnished by the equipment manufacturer.

Final Cleanup

1. Upon completion of the electrical work, remove all surplus materials, rubbish, and debris that accumulated during the construction work. Leave the entire area neat, clean and acceptable to the Owner.
2. Lamps and fluorescent tubes shall be cleaned, and defective units replaced at the time of final acceptance.

16.15 Grounding and Bonding for Electrical Systems

[CSI 26 05 26]

Part 1 - General

References

Service and equipment grounding shall be per Article 250 of the NEC.

Performance Requirements

Verify that a low-resistance ground path is provided for all circuits so an accidental contact to ground of any live conductor will instantly trip the circuit.

Part 2 - Products

Components

The grounding systems shall consist of the ground rods, grounding conductors, ground bus, ground fittings and clamps, and bonding conductors to water piping and structural steel as shown on the Plans.

System components shall be as allowed in the NEC unless specified otherwise below:

1. Ground Rods: Ground rods shall be cone pointed copper clad Grade 40 HS steel rods conforming to ASTM B228. The welded copper encased steel rod shall have a conductivity of not less than 27 percent of pure copper.
2. Ground Conductors: Buried conductors shall be medium-hard drawn bare copper; other conductors shall be soft drawn copper. Sizes over No. 6 AWG shall be stranded. Coat all ground connections except the exothermic welds with electrical joint compound, non-petroleum type, UL listed for copper and aluminum applications.
3. Ground Rod Boxes: Boxes shall be a 9-inch diameter precast concrete unit with hot-dip galvanized traffic cover. Boxes shall be 12-inches deep minimum. Covers shall be embossed with the wording "Ground Rod".

Part 3 - Execution

General Grounding Installation

When available a UFER ground per latest edition of NEC shall be provided as the primary means to ground the electrical system.

Ground electrical service neutral at service entrance equipment to supplementary grounding electrodes.

Ground each separately derived system neutral to nearest effectively grounded building structural steel member or separate grounding electrode.

Provide a ground rod box for each ground rod to permit ready access to facilitate testing.

Provide a ground wire in every conduit carrying a circuit of over 110 volts to ground.

Make embedded or buried ground connections, taps and splices with exothermic welds. Coat ground connections.

Bond metallic water piping at its entrance into each building.

Motor Grounding Installation

Extend equipment ground bus via grounding conductor installed in motor feeder raceway. Connect to motor frame.

When using nonmetallic flexible tubing install an equipment grounding conductor connected at both ends to noncurrent-carrying grounding bus.

Ground Connections

Above grade ground connections shall be exothermic weld, mechanical, or compression-type connectors; or brazing.

Below grade ground connections shall be exothermic weld.

Install all ground connections in strict accordance with connector manufacturer's recommendations and methods.

Testing

Following completion of the grounding electrode system, if installed, measure ground resistance at each ground rod using the three-rod method. Submit results to engineer prior to final acceptance by the Owner.

Perform testing per NETA Standard ATS paragraph 7.13. Testing methods shall conform to NETA Standard ATS using the three-electrode method for large systems. Conduct tests only after a period of not less than 48 hours of dry weather.

Furnish to the Engineer a test report with recorded data of each ground rod location. See Division 16.95.4.

16.30 BASIC PANEL EQUIPMENT AND DEVICES

16.31 Operating and Indicating Devices

[CSI 26 09 00, 40 78 00]

Part 1 - General

Operating and indicating devices minimum rating shall be NEMA 13. Operator devices mounted in outdoor panels, corrosive areas or where exposed to moisture shall be NEMA 4X.

16.31.1 Digital Power Meter

[CSI 26 09 13.12, 40 78 13.21]

Manufacturers

The digital power meter shall be a Siemens, PAC4200, no substitutions.

Minimum Features

A digital 3-phase power monitor with remote capabilities and associated sensors shall be provided as indicated on the Plans. The digital power meter shall be capable of measuring at a minimum the following parameters:

1. Voltage (line-neutral)
2. Voltage (line-line)
3. Voltage unbalance
4. Current
5. Current unbalance
6. Neutral amps
7. Real power
8. Reverse and single-phase detection
9. Reactive power
10. Apparent power
11. Power factor
12. Frequency
13. Auxiliary voltage

Power meter shall have an RJ-45 Ethernet port for communicating with the facility control system. Power meter shall communicate with the control system via Profinet communications protocol.

16.31.2 Run Time Meters

[CSI 26 09 13.22, 40 78 13.22]

Manufacturers

Siemens or equal.

Manufactured Units

Hour meter (elapsed time meters) shall be 2-inch by 1-inch nominal size, rectangular case type for flush panel mounting. The meter face shall be of the style that most closely resembles the panel indicating instruments if provided and shall have black trim with white or aluminized face. The meters shall have a 6-digit non-resettable register with the last digit indicating tenths of an hour.

16.31.3 Start Count Meters

[CSI 26 09 13.23, 40 78 13.23]

Manufacturers

Siemens or equal.

Manufactured Units

Start counters shall be 2-inch by 1-inch nominal size, rectangular case type for flush panel mounting. The meter face shall be of the style that most closely resembles the panel indicating instruments if provided and shall have black trim with white or aluminized face. The meters shall have a 6-digit resettable register.

16.31.4 Indicating Lights

[CSI 26 09 13.31, 40 78 16]

Manufacturers

Heavy-Duty, Watertight, and Corrosion-Resistant Type:

- Siemens

Manufactured Units

Indicating lights shall be NEMA type 4/4X/13, corrosion resistant, water-tight, oil-tight, full voltage, push-to-test, high visibility 28 chips LED type. Pilot lights shall be rated for the proper operating voltage. Appropriate lens caps shall be provided as shown on Plans.

16.31.5 Selector Switch

[CSI 26 09 16.21 40 78 19.21]

Manufacturers

Heavy-Duty, Watertight, and Corrosion-Resistant Type:

- Siemens

Manufactured Units

Selector switches shall be NEMA type 4/4X/13, corrosion-resistant/watertight/oil-tight, type selector switches with contacts rated for 10 amperes continuous at proper operating voltage. Operators shall be black knob type. Units shall have the number of positions and contact arrangements and spring return function (if any) as shown on Plans. Units shall be single-hole mounting, accommodating panel thicknesses from $\frac{1}{16}$ -inch minimums to $\frac{1}{4}$ -inch maximum.

16.31.6 Pushbuttons

[CSI 26 09 16.23, 40 78 19.25]

Manufacturers

Heavy-Duty, Watertight, and Corrosion-Resistant Type:

- Siemens

Manufactured Units

Pushbuttons shall be NEMA type 4/4X/13, corrosion-resistant/watertight/oil-tight, type push buttons with momentary contacts rated for 10-ampere continuous at proper operating voltage. Button color shall be as specified in control panels and shall have a full guard.

Pushbutton contact arrangements shall be as shown on Plans. Size of pushbuttons as indicated on the Plans.

Special Functions

Pushbutton for “emergency stop” applications shall have maintained contacts and red mushroom head operators.

16.32 Panel Relays

[CSI 26 09 16, 40 78 53]

Part 1 – General

General

Relays shall be provided as necessary to perform switching functions required of control panels and other control circuits as shown on the Plans and described in the technical specifications. Appropriate relay type and associated contacts shall be selected based on the application from the control wiring diagrams or the functional description. Where timing relays and control relays require additional contacts, provide auxiliary control relays properly sized for the application.

All contacts and relays shall be NEMA rated and UL recognized.

The electrical life expectancy for the relay shall be over 500,000 operations at 120V AC, 10 amp; (over 200,000 operations at 120V AC, 10 amp for SPDT, 3PDT, and 4PDT). The mechanical life expectancy for the relay shall be over 50,000,000 operations.

16.32.1 Control Relays

[CSI 26 09 16.31, 40 78 53.21]

Manufacturers

- Square D Class 8501, Type K or R
- Allen Bradley 700 Type HA or HB
- IDEC RH Series; or equal

Manufactured Units

Relays for general purpose use shall be DPDT or 3PDT, 10-amp contacts with the appropriate coil voltage for the application. Relays shall be plug-in type with matching socket. All relays shall have LED indicators to signal when the coil is energized. Relay coils shall be rated for continuous duty.

16.32.3 Time Delay Relays

[CSI 26 09 19.35, 40 78 53.25]

Manufacturers

- Allen-Bradley 700 Type HR

- IDEC GE1, RTE or GT3 Series; or equal

Manufactured Units

Time delay relays shall be multi-function, multi-range with plug-in base, pin style terminations timing and timed out LED indicators, and calibrated scales. Relays shall have minimum 0.5 seconds to 60 minutes, 8 selectable timing ranges, 5-amp contacts. Select coil voltage for the application. Units shall be sealed to prevent entry of contamination in the form of dust, dirt, or moisture.

Appropriate relay shall be selected based on application from the control wiring diagrams.

Minimum accuracy (plus or minus) shall be as follows:

1. Repeat accuracy – ½ percent.
2. Timing change over full voltage range – ½ percent change over full temperature range.
3. Scale tolerance – 5-percent.

16.35 Control Panel Accessories

16.35.1 Terminal Blocks

[CSI 26 05 83 or 26 27 26]

Part 2 – Products

Manufactured Units

Terminal blocks shall be one-piece, molded, plastic blocks with screw-type terminals and barriers rated for 600 volts. Terminals shall be double-sided and supplied with removable covers to prevent accidental contact with live circuits. Terminals shall have permanent, legible identification, clearly visible with the protection cover removed.

Part 3 – Execution

Installation

All wires between panel-mounted equipment and other equipment shall be terminated at terminal blocks. Switches shall be terminated at the terminal blocks with crimp-type, pre-insulated, ring-tongue lugs. Lugs shall be of the appropriate size for their terminal block screws and for the number and size of the wires terminated. All wires shall be labeled with the circuit number and common function.

16.35.2 Nameplates

[CSI 26 05 53, 10 14 23]

Part 2 – Products

Manufactured Units

Standard nameplates shall be made of 1/16-inch thick machine engraved laminated phenolic having black letters not less than 3/16-inch high on white background. One-inch high lettering

shall be used for the large nameplates required for the control panels and motor control centers.

Part 3 – Execution

Installation

Nameplates shall be provided on all electrical devices including but not limited to motor control equipment, MCC cubicles, control stations, junction boxes, panels, motors, instruments, switches, indicating lights, meters, and all electrical equipment enclosures. Each motor control center compartment and control panel shall have a nameplate designating the equipment and its identifying number and size or rating. Data shall be as shown on the Plans and reviewed via the submittal process. Nameplates shall have name, number and/or function as is applicable for clear identification.

Provide one large nameplate for each motor control center and/or control panel identifying the equipment as indicated on the Plans.

Nameplates on steel panels shall be secured with stainless steel drive screws. Where it is proposed that nameplates will be secured with pressure sensitive tape or bonding cement, the process and samples shall be submitted to the Engineer for acceptance.

Nameplates shall be provided for identifying all operator interface (lights, switches, etc.) and other devices that are located outside or inside the panels.

Nameplates shall be provided for identifying all relays and devices that are located inside the panels.

Special Functions

Provide warning nameplates on all panels and equipment, which contain multiple power sources. Lettering shall be white on red background.

16.36.1 Surge Protection Device (SPD)

[CSI 26 43 13, 40 78 56]

Part 2 – Products

General

The SPD shall be compatible with the electrical system voltage, current, system configuration, and intended applications.

Manufacturers

The SPD shall be manufactured by the motor control center manufacturer.

Manufactured Units

Protect the electrical service with an SPD device as shown on the Plans. The SPD shall be mounted in the motor control center. The SPD shall meet the following:

1. Provide surge current withstand up to 160 kA per phase.
2. Short circuit current rating of 200 kAIC.
3. A ten-year free replacement warranty.
4. Enhanced UL 1283 Transient Tracking Filter.
5. NEMA 4 – weatherproof steel enclosure
6. Status indicator lights for each phase and one service LED.

16.36.2 Power Factor Correction Capacitors

[CSI 26 35 33]

Part 2 – Products

Manufactured Units

Furnish and install automatic power factor correction capacitor equipment as specified herein and shown on the associated electrical plans. The supplier of the motor control panel shall provide the automatic power factor control equipment.

Individual capacitors shall be provided with the following features:

1. NEMA 1 enclosures designed for wall mounting unless provided in the MCC.
2. Pressure sensitive interrupters for cell protection.
3. Discharge resistors.
4. Current limiting fuses and blown fuse indicators in each phase.

Power factor correction capacitors shall be coordinated with the motor to provide 0.92 to 0.95 power factor. The motor control panel supplier shall coordinate with the motor manufacturer to correctly size the power factor correction capacitors.

Part 3 – Execution

Installation

A 3-phase contactor shall be provided and wired to the line side of each solid-state starter to connect the power factor correction capacitor into the circuit when the motor is running at full speed. Control wiring shall be provided from the starter controls.

16.40 LOW VOLTAGE MOTOR CONTROL EQUIPMENT

[CSI 26 29 00]

16.41.1 Motor Control Center

[CSI 26 24 19]

Part 1 - General

Description of Work

The Control System Integrator, S&B Inc., shall furnish the motor control center for installation by the Contractor in the Electrical and Communications Building including all related equipment as shown on the Plans and specified herein.

Related Sections

- Division 16.30 Basic Panel Equipment and Devices
- Division 16.41.2 Standard Motor Starter Units
- Division 16.41.3 Solid State Reduced Voltage Starters
- Division 16.45 Variable Frequency Drives

References

The equipment shall be constructed to meet or exceed the requirements within NEMA ICS3-322 and UL845 for motor control centers. Each MCC section shall bear the UL label.

Coordination

The supplier of the motor control center shall equip the assembly with all appurtenances and accessories (including but not limited to control relays, control contacts, control wiring and terminal strips) as required for interface with the mechanical equipment and motor to provide a totally integrated and operable system.

Design Requirements

This equipment shall consist of a line-up of standard design, free-standing sheet metal sections, assembled and pre-wired for motor control and power distribution as shown on the Plans. This equipment shall be designed as to permit future additions of vertical sections and interchanging of units by users. Include provisions for supervisory control equipment as specified elsewhere.

Each unit shall be completely prewired with all control wiring numbered and terminated on terminal strips. No terminal strips are required for the load wiring. Auxiliary components such as HOA selector switches, indicating lights and other indicating and/or recording devices shall be mounted on the compartment door or cover. All control power leads into and out of each unit shall pass through a ganged knife blade control power disconnect switch. The control power disconnect shall be identified as such.

The equipment enclosure shall be NEMA Type 1A with gasketing unless noted otherwise on the Plans. Gasketing shall be closed cell neoprene material.

The MCC shall be NEMA Class II, Type B construction.

The MCC shall be rated as shown on the Plans with a minimum available fault current withstand rating of 42,000 amperes without a neutral conductor in the MCC.

Submittals

Provide submittals for all components.

Part 2 – Products

Manufacturers

During design, Siemens Tiastar MCC equipment was used for sizing. MCC manufacturer shall be one of the following manufacturers:

- Siemens Tiastar MCC with Internal Profinet Network

Finishes

Surfaces shall be painted according to the manufacturer's standard color scheme. All unpainted parts shall be plated for resistance to corrosion.

Components

Communications

1. All power monitoring equipment and motor operating equipment including overload units, SSRVS and VFDs shall communicate with the telemetry system via an Profinet networking system.

Vertical Sections

1. Each vertical section shall be approximately 90 inches high and 20 inches deep. Vertical sections shall have internal base mounting angles at the bottom and external lifting angles at the top running continuously within each shipping block.
2. To minimize the chance of fault propagation to adjacent sections, each vertical section shall have side sheets extending the full height and depth of the section.

Incoming Line Compartments

1. Incoming line/lug compartment shall be top entry unless noted otherwise on the Plans. The size and quantity of incoming cables shall be as shown on the Plans.

Bus

1. The main horizontal bus shall be as indicated on the Plans. Horizontal bus bars shall be located at the top of the MCC. All power bussing shall be braced to withstand a fault current of 42,000 RMS symmetrical amperes unless otherwise noted on the Plans.
2. Bus supports shall be fabricated from high strength, glass-filled polyester resin.
3. The horizontal bus shall be tin plated copper with a conductivity rating of 100 percent AICS. The horizontal bus bars shall be fully sized to carry 100 percent of the rated current the entire length of the MCC. The entire horizontal bus assembly shall be located behind the top horizontal wireway. Horizontal bus bars located behind usable unit space are not acceptable.

4. The horizontal bus shall be isolated from the top horizontal wireway by a clear, flexible, polycarbonate barrier allowing visual inspection of the horizontal bus without removing any hardware.
5. The vertical bussing shall be rated 300 amperes respectively. Vertical bus bars shall be fabricated of tin-plated solid copper bars with a conductivity rating of 100 percent AICS. The vertical bus barrier support shall be designed as to effectively enclose each vertical bus bar. Provisions shall be made to close off unused unit stab openings in the vertical bus barrier with removable covers.
6. All bus ratings are to be based on a maximum temperature rise of 50 degrees Celsius over a 40-degree Celsius ambient temperature.
7. Provisions for terminating a neutral wire shall be provided.

Unit Disconnect Operator Mechanism

1. A door-mounted operator mechanism shall be provided for operating all feeder breakers provided with the MCC. The operator shall extend through an opening in the unit door and shall clearly indicate whether the disconnect is ON, OFF, or TRIPPED.
2. With the disconnect in the ON position, a mechanical interlock shall prevent opening of the unit door. This interlock shall be provided with a defeater so that authorized personnel may gain access to the compartment without interrupting service.
3. The operator mechanism design shall allow padlocking the disconnect in the OFF position with up to four padlocks.

Wireways

1. Horizontal wireways of standard sections, both top and bottom, shall be not less than 6 inches high. To prevent damage to cable insulation, the wireway opening between sections shall have rounded corners and the edges shall be rolled back.
2. A full height, vertical wireway and hinged door shall be provided in each standard vertical section. A permanent vertical wireway wall shall separate the units from the vertical wireway and remain intact even when the units are removed.

Operator Interface Devices and Control Relays

1. This section covers all components required in a motor control center that require operator interface devices and control relays. Nameplates shall be provided for each control component. The nameplate shall be phenolic, black background with white lettering.
2. See Division 16.30 Basic Equipment and Devices.

Units

1. After insertion, each plug-in unit shall be held in place by a latch that is located at the front of the unit.
2. Plug-in stabs shall be mounted in a polyester molding at the rear of the unit. Wiring from the unit disconnecting means to the plug-in stables shall be routed into this molding such that the wiring is not being exposed at the rear of the unit.

3. Size 1 through Size 5 non-reversing starters shall be plug-in units.
4. The unit door shall be fastened to the stationary structure (not the unit itself), so that the door can be closed when the unit has been removed. The door shall be hinged on the left-hand side so that it opens away from the vertical wireway.
5. The operator handle of all units shall be interlocked with the MCC frame, so that a unit insert cannot be withdrawn or inserted when the operator is in the ON position. Position of operating handle shall indicate ON, OFF, or TRIPPED condition. Handle shall provide provisions for padlocking in the OFF position. Interlock provision shall prevent unauthorized opening or closing of the door with the disconnect in the ON position.
6. Circuit breaker type starter units shall have a short circuit rating greater than the available fault current listed in the General Section and shall be motor circuit protectors (MCP) with magnetic only trip. Feeder breakers shall be molded case breakers with thermal magnetic trip and have a short circuit rating greater than the available fault current listed in the General Section.
7. An auxiliary contact shall be provided on the disconnect for purposes of isolating the external source of control voltage. One control circuit fuse shall be provided.
8. Control circuit transformer (CCT) shall be mounted within the unit. CCT shall be individually protected, and provide the following excess capacity, in addition to that required by the starter coil: Size 1 – extra 40VA, Size 2 – extra 40VA, Size 3 – extra 125VA, Size 4 – extra 180VA, Size 5 – extra 200 VA.

Power Monitoring

1. See Division 16.31.1

Surge Protection Device (SPD)

1. See Division 16.36.1

Integration with Telemetry

1. The Manufacturer of the MCC shall determine all requirements for transmitting data to the telemetry system and shall include in the panel all required devices and equipment for interfacing contact closures.

Wiring Diagrams

1. Wiring diagrams shall be provided at a centralized location in the MCC. The diagram shall show the exact devices inside the unit and shall not be a generic diagram. The supplier of the equipment shall have the capability to provide revisions to electronic files of wiring diagrams at a local office. The wiring diagrams must be provided with product submittals in order to be considered for review. Supplier shall provide a disk copy of all plans in AutoCAD format.
2. Before the MCC can be shipped to the jobsite, the final wiring diagrams must be submitted to the Engineer for review and approval. The final wiring diagrams must reflect all changes made at the factory or integrator's shop before the diagrams will be approved.

Wire and Control Relay Identification

1. All control wire in MCC shall be marked with shrink type wire markers on both ends of wire. All control relays provided in the MCC panel shall be permanently labeled. The label for the control relays and wiring shall match the wiring diagrams.
2. All wire and control relay identification must be correct before the MCC can be shipped to the jobsite.

Profinet Communication

General

1. The MCC shall have Ethernet wiring incorporated into its design.
2. The MCC shall have Ethernet cabling incorporated throughout the vertical section.
3. Each motor starter, AC drive and soft starter unit in the MCC shall be supplied with a means to communicate via Profinet network.

Ethernet Cabling

1. Ethernet Cable Ratings
 - a) The Ethernet cable shall be 600V UL PLTC rated.
 - b) The use of 300V cable is not acceptable.
2. Layout
 - a) Cable shall connect each section to one another in the top or bottom wireways.
 - b) Ethernet cable through the MCC section shall be routed from the top or bottom wireways. To prevent accidental damage during MCC installation, the cable shall be located behind barriers to isolate the cable from the unit space and wireways.
 - c) Eight Ethernet ports shall be provided in the rear of each vertical wireway of standard sections to simplify installation, relocation, and addition of plug-in units.
 - d) The Profinet device within each unit shall be factory connected to an Ethernet port in the vertical wireway by using a 600V-rated Ethernet cable.
3. Power Supplies
 - a) The power supply shall provide 24V DC for the devices that require it.
 - b) The MCC manufacturer shall check the user's design to ensure that adequate power supplies have been specified to conform to network requirements.
 - c) Power supply output shall be rated 8 Amps, 24 VDC.
 - d) The power supply unit shall be provided with a buffer module to provide a minimum of 500 ms ride-through at full load.

Profinet Interface For Variable Frequency AC Drives

1. The Profinet communication interface shall be supplied to allow for communication between solid-state component and the Ethernet network.

Profinet Interface for Other Units

1. Provide a Profinet interface for other units as indicated on the Plans.
2. Refer to the Plans wiring for points to be monitored.

Programming and Testing

1. The MCC manufacturer shall provide programming and testing requirements as follows:
 - a) The MCC manufacturer shall load the IP Address into each unit.
 - b) The IP Address shall be as indicated on the contract Plans or as provided by the Engineer.
 - c) The MCC manufacturer shall test the MCC to ensure that each unit communicates properly prior to shipment.
 - d) Each unit shall have a label showing the IP Address for the devices within it.

Part 3 - Execution

Testing

This equipment shall be tested and placed into operation by a qualified factory representative trained in start-up and troubleshooting procedures for equipment being installed.

All Motor Control Center components shall be factory tested both at the manufacturer's facility and the Control System Integrator's shop. Factory testing shall be witnessed by the Engineer.

16.41.2 Standard Motor Starter Units

[CSI 26 29 13.13]

Part 1 - General

Design Requirements

Each unit shall consist of a motor circuit protector and a magnetic starter. The combination shall have an interrupting rating of not less than 42,000 amperes symmetrical at 480 volts. Each unit shall have a control terminal board and other components as shown on Plans.

Starters shall be of NEMA, not IEC design. That is, starters shall have molded coils, replaceable contacts, and metal mounting plate. Starters shall have provisions for accepting up to seven (7) auxiliary contacts and one (1) overload alarm contact.

All starters shall be size 1 or larger and no intermediate sizes (such as 1^{3/4}) will be acceptable.

Pilot devices shall be per Division 16.30 Basic Panel Device and Equipment.

Part 2 – Products

Manufactured Units

Overload protection is to be provided by a solid-state overload relay that shall be self-powered. Each overload shall be adjustable over a full 2:1 FLA adjustment range. A tamper proof cover shall be provided. The standard overload shall provide Class 20. The overload relay must

provide phase loss protection. The overload must be ambient insensitive. The overload relay must have a trip-free, normally-closed contact with a visible trip indication and N.O. isolated alarm contact. The overload shall have a method of being manually tripped for test purposes. Size the overload heaters to protect the motor actually installed with allowance for power factor correction, if applicable.

The overload relay shall be a Siemens Simocode unit or equal and shall include the following features:

1. Built-in Profinet communication
2. LEDs for status indication.
3. Test/Reset button.
4. (4) Discrete Inputs and (2) Discrete Outputs.
5. Protective functions including: programmable trip level, warning level, time delay, inhibit window, thermal overload, phase loss, stall, jam, underload, current imbalance, remote trip, and PTC thermistor input.
6. Current monitoring functions including: phase current, average current, full load current, current imbalance percent, percent thermal capacity utilized, and ground fault current (if required).
7. Voltage, energy, and frequency measuring capabilities.
8. Diagnostic information including: device status, warning status, time to reset, trip status, time to overload trip, and history of last five trips.
9. Preventative maintenance information including: allowable starts per hour, required time between starts, starts counter, starts available, time until next start, total operating hours, and elapsed operating time.

Terminal blocks shall be mounted within the unit and located near the front for accessibility. They shall not be located at the rear of the vertical wireway. Power terminal blocks shall be provided. On non-plug-in (frame mounted) units, terminal blocks need not be pull-apart style. On plug-in units, control terminal blocks shall be pull-apart style.

Starter units shall contain the number of auxiliary contacts, unit-mounted devices, indicating lights, control relays, and other devices as shown on the Plans.

16.41.3 Solid State Reduced Voltage Starters

[CSI 26 29 13.16]

Part 1 - General

Scope

This specification describes the performance, functional specifications and fabrication details for a digital reduced voltage, stepless, solid state motor starter that shall provide a selectable voltage ramp, current limit or torque ramp (all standard) method of soft starting 3-phase AC induction motors.

The motor starter shall be self-contained and house the solid-state controller, motor overload protection (Class 10 through Class 30 selectable), an integral bypass contactor and a disconnect means as required on the plans, in one enclosure or motor control center section.

The SSRVS control shall be integrated with a motorized valve actuator system as shown on the Plans.

Related Documents

Drawings and general provisions of the Contract shall apply to this section.

Submittals

Submit shop drawings and product data for approval and final documentation in the quantities listed according to the Conditions of the Contract. All transmittals shall be identified by customer name, customer location and customer order number.

Units shall be shipped with a complete set of documentation to include the following items:

1. Complete schematics and wiring diagrams
2. Enclosure outline drawings
3. System instruction manuals
4. Contactor and disconnect system data, if applicable
5. All drawings shall be done in AutoCAD and shall be available on electronic medium.
6. All of the above will be required at the time of approval.

Codes and Standards

Manufactured Unit(s) shall meet the codes listed in the NEC.

Stand-alone units shall be combination starters with circuit breakers and shall be UL listed for use in combination with the specific associated circuit breaker per applicable UL-508 standards. If used in Motor Control Centers, the complete starter units will be UL listed under UL-845 as part of the MCC.

Quality Assurance

The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of sixty (60) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

All incoming material shall be inspected and/or tested for conformance to quality assurance.

Power semiconductors shall be fully tested for proper electrical characteristics (dv/dt, di/dt, etc.).

All subassemblies shall be inspected and/or tested for conformance to vendors engineering and quality assurance specifications.

Printed circuit boards shall be burned in for a minimum of 48 hours at 60 degrees Celsius.

The complete unit shall be functionally tested under load before shipment to assure proper operation per specification. Complete test reports shall be available upon request

Spare Materials

Provide one (1) set of (3) of each size power fuse utilized.

Provide one (1) spare control relay for each unique relay utilized on the project.

Part 2 – Products

Manufacturers

The Siemens 3RW44 SSRVS with Profinet communications shall be manufactured by Siemens, no substitutions.

The SSRVS units shall be of the same manufacturer and supplier as the MCC as required for interface with the master control system to provide a totally integrated and operable system.

Design

Power Ratings

Input: 200 – 460V ± 15 percent, 3 phase 50 / 60Hz (selectable) ± 10 percent. Unit(s) will operate with any incoming phase sequence.

Output: Reduced voltage 3 phase AC derived from phase-angle fired inverse-parallel thyristors, ramped to full voltage.

Current Rating(s): Shall be, at a minimum, capable of the motor Full Load Amps for the Horsepower(s) indicated on the Plans, including any Service Factors.

1. Current ratings of starter chassis must be based on manufacturer's data showing they were tested at 50 degrees Celsius.

Output Overload Capacity: Shall be as follows, based upon motors indicated on the Plans and specified elsewhere:

1. For units used on motors where Class 10 overload protection is required, the soft starter shall be capable of delivering 550 percent of the motor FLA for 10 seconds.
2. For units used on motors where Class 20 overload is required, the soft starter shall be capable 550 percent of motor FLA for 20 seconds
3. If the motor is capable of Class 30 protection, the soft starter shall be capable of delivering 550 percent current for 30 seconds.
4. Continuous duty rating shall be for the motor FLA plus + 15 percent.
5. Lighter duty rated starters are not acceptable

SCCR (Short Circuit Current Rating) Listing: Combination starter units shall be UL listed to withstand the Available Fault Current of the system as indicated on the Plans or as determined prior to installation. For retrofit applications, both the soft starter and circuit breaker shall be supplied so that the SCCR rating of the combination is capable of withstanding the Available

Fault Current. SCCR ratings in combination with the Circuit Breaker shall be published and supplied by the manufacturer with submittals.

Control Power: 120VAC, 60Hz provided by a Control Power Transformer with primary and secondary fusing, adequate to operate all associated devices in each starter.

Power Devices (SCRS)

PIV Ratings: Minimum 2.5 times nominal line voltage.

Protection: RC snubber network circuits on each phase assembly and MOV protective devices on the gate circuits.

Efficiency: 99.7 percent through SCRs, 99.97 percent when bypass is engaged.

Bypass Contactor

All units shall have an integral Bypass Contactor to shunt motor power around the SCRs when at full speed. The soft starter shall include all necessary control circuitry to accomplish this without the need for external timers and engage the Bypass Contactor only when the microprocessor has determined that the motor has reached speed.

1. Overload Protection shall be integral and continuous so that it is in the motor circuit at all times, even when the Bypass Contactor is engaged.
2. Decel Interlocking shall be integral to allow the soft starter to automatically disengage the Bypass Contactor when a Decel command is given.
3. Where shown on the plans, the SSRVS shall be provided with an external Bypass Contactor with high security key selector switch. The external Bypass contactor shall meet all of the above control and protection conditions.

Product Features

The starter shall be complete with standard features and adjustments as follows:

Acceleration Control shall be fully adjustable in programming to match any application. As a minimum, starter shall come complete with the following settings:

1. Ramp Type: To ensure maximum flexibility in matching any unforeseen load conditions in the field, the starter shall provide all of the following methods of closed loop acceleration ramp control:
 - a) Voltage Ramp
 - b) Current Limit Only (Current Step)
 - c) Closed Loop Torque
 - d) In addition, the soft starter shall be capable of being programmed to start the motor Across-the-Line for testing purposes. To avoid problems in commissioning once the field application conditions are known, any starter that has limited ramp choices will not be acceptable.
2. Starting Torque: Initial torque output shall be programmable as either Voltage or Torque output depending on the selected ramp profile, and adjustable between 50-200 percent of motor Full Load Torque.

3. Maximum Current Limit: To ensure acceptability to power conditions and reliability of starting under any circumstance that the motor can function in, a Current Limit function shall be available in all starting ramp modes, adjustable between 150 and 550 percent of the unit rating. Starters which do not provide Current Limit in all starting modes will not be acceptable.
4. Ramp Time: The time between Initial Torque and Full Output shall adjustable between 1 and 360 seconds.
5. Kick Start: To provide for starting of difficult loads, the starter shall include a Breakaway Pulse (Kick Start) feature that will apply a high output for a short time on initial start command. The Kick Start voltage level shall be adjustable from 40 – 100 percent voltage, for 0.1 to 2 seconds max.
6. Slow Speed Jog: For checking rotation at start-up or other testing procedures, the starter shall provide a programmable Slow Speed Jog feature, initiated by the Operator Interface or via input. The Slow Speed Jog output shall be programmable as a percentage of the base motor speed, not exceeding 21 percent.
 - a) Slow Speed Reverse: For testing purposes or to provide for special applications as indicated on the drawings, the soft starter shall be capable of rotating the motor in the reverse direction upon command from the operator interface or via inputs. This feature shall be integral to the soft starter or modifications shall be provided to accommodate it.

Deceleration Control (Controlled Ramp Down)

To facilitate the controlled deceleration of pumps and other loads, Decel Torque Control and/or Pump Control shall be built in and selectable with the following adjustments, all of which are independent of any Acceleration Ramp settings:

1. Deceleration Ramp Time: adjustable from 0 – 360 seconds to allow gentle controlled deceleration in excess of the natural coast-to-stop time of the load.
2. Stop Torque Level, adjustable from 10-100 percent to automatically turn off the starter when the output torque has reached a desired level, i.e. when a check valve has closed.

Selectable Ramp Profiles

To accommodate changeable conditions, the starter shall provide 3 separately adjustable ramp profiles, selectable via a dry contact closure. Each ramp will provide all of the above features.

Motor and Load Protection shall be integral to the starter assembly. All current referenced protection features shall be automatically calculated from the motor nameplate FLA as entered by the user. All time-based protection features shall have retentive memory so that they remain active should the power fail and be restored. Starter shall provide the following functions:

1. I2t Thermal Overload shall be provided by the on-board microprocessor control based on inverse time-current trip curves as defined by NEMA trip curve Classes. The trip curves classes shall be programmable from between Class 5 and Class 30 and the starter shall be UL listed to provide each individual class. As the most important protection feature of a starter, the overload protection shall be based on a Motor Thermal Model retained in memory and provide the following features:

- a) Retentive Thermal Memory shall be used to ensure that the overload protection does not lose track of motor temperature after the power is lost or shut down. Upon reapplication of power, the microprocessor shall be updated as to the motor thermal state. This feature shall be capable of being overridden for emergency re-start applications.
- b) Manual or Automatic Reset shall be selectable in programming to provide for automatic reset in unattended remote applications.
- c) Thermistor Input shall be provided in case the motor or equipment arrives with integral Thermistors to monitor temperature. The Thermistor input shall provide for a motor thermal temperature monitoring that will bias the Motor Thermal Model mentioned above based on actual motor temperature.
 - i. The Thermistor monitoring circuit shall detect broken or shorted field devices or wiring.
 - ii. Units without this feature shall provide external Thermistor Protection Relays if necessary and provide a way for the soft starter to display a Thermistor Trip independently of a Motor Overload trip.

Phase-Loss Protection shall be standard and shut down the starter if current through any leg drops to 20 percent of the programmed motor FLA or less, independent of line voltage levels.

For purposes of testing with smaller motors, each starter shall be capable of having the motor FLA adjusted down to 20 percent of the unit Max Amp rating so that this feature will not trip if a load less than 20 percent of that setting is connected (i.e. 4 percent of unit maximum rating).

Phase Current Imbalance shall be used to bias the Motor Thermal Model so that the tripping curve reflects the additional motor heating caused by the imbalance.

The "Pick-up Point" of this feature shall be programmable or able to be defeated so that nuisance tripping can be avoided.

Ground Fault Protection shall be included which will prevent a start-up if any phase is connected to Ground or trip while running.

Over Current / Shear Pin Protection shall be provided. This Over Current trip shall be adjustable at lower levels than the Thermal Overload protection for the purpose of protecting mechanical components from undue shock when rapid unexpected load changes occur.

Adjustment level shall be from 50 percent to 150 percent of the programmed motor FLA

Under Current / Load Loss Protection shall shut down the starter on an adjustable Under Current condition. This shall be programmable as follows:

Adjustment level shall be from 19 percent to 100 percent of the programmed motor FLA

Over and Under Voltage Protection will cause a trip if the voltage dips or surges beyond the unit tolerance limits for both the line voltage and the control voltage, differentiating the trip cause between the two systems on the Operator Interface Display.

Starter Protection shall be provided to maintain reliability of both the equipment and the circuit components, with the following features:

1. Shorted SCR / Welded Contactor Detection shall be standard. This function must automatically prevent the next start when at least one SCR is shorted, or the Bypass Contactor is welded.
2. Starter Overtemp Trip shall be built-in and protect the SCRs from excessive heat build-up in the heat sink. This function shall also detect a broken wire or defective sensor.

Input / Output features shall be as follows:

1. Four (4) Inputs shall be provided for the control and option selection of the starter as follows. All input and control devices shall be 24VDC control from a built-in power supply, requiring only dry contact closures. All I/O termination points shall incorporate easily removable terminal blocks to facilitate quick change-out or troubleshooting isolation in the field.
 - a) Input commands shall be programmable for any one of the following functions; Motor Right (Fwd), Motor Left (Rev), Parameter Set 1, 2, or 3, Trip Reset, Quick Stop, Slow Speed, Emergency Restart, and Local Override for allowing local control when using Serial Communications as the control point.
2. Four (4) Output Relays shall be provided; three outputs shall be Form A (SPST), the fourth shall be Form C (SPDT), all rated for 240VAC, 3 Amps max.
 - a) Each relay shall be fully programmable for any one of the following functions; PIO Output 1, PIO Output 2, Input Status (1-4), Run up (Accelerating), Operation/bypass, Coasting down, On time motor (Running), Motor-on commanded, DC braking Contactor, Group warning (no trip), Group error (Fault trip), Bus error, Device (starter) error, Power on, Ready to start.
 - b) Operator Interface panel shall be included which provides simple to use adjustment and status indication on a dead-front shroud of the starter. This panel shall be capable of being remotely mounted up to 10 feet away from the starter chassis, such as on the front door of the enclosure.
 - c) Adjustments shall be made by keypad with tactile feedback keys for high noise environments. No binary coded dialswitches shall be used for programming. Pass code protection shall be available to prevent unauthorized changes to the programming.
 - d) Graphical User Display shall be backlit LCD for long life and visibility in low contrast environments. Display shall have a minimum of 4 lines of alpha-numeric characters, programmable in 4 languages and capable of displaying all digits in displayed parameter so that operators do not need to calculate current values over 999A.

Metering functions shall be provided through the Alpha-Numeric Display for indicating the following:

1. Output Current for each individual phase. Indicating range to be 0.0 – 9999 amps.
2. Voltage: Phase-to-phase and Phase-to-ground voltages shall be available for display
3. Frequency, for use in generator operation diagnostics.

4. Motor Thermal Status to indicate heat build-up in the motor. Range shall be 0 – 100 percent of the motor thermal capacity and count up towards 100 percent while heating.
5. Elapsed Time shall indicate the number of hours that the starter has been in a Run condition, maximum 100,000 hours.
6. Start Counter, indicating the number of Run commands given.

Serial Communications shall be available as an optional feature and supplied as indicated on the Plans.

1. Communications protocol shall be Profinet.
2. PC interface and software shall be available either through the local programming port via USB connection, or over the Profinet connection (if installed).

Historical Data shall be recorded and displayed, plus made available for communication. It shall be retained in non-volatile memory for viewing by service personnel later.

1. History shall include fault conditions experienced by the starter and peak running details.

Mechanical Construction

Enclosure shall contain the digital solid-state controller and disconnect means (optional) as required.

1. Rating shall be as indicated on the Plans.
 - a) NEMA 1 enclosed units shall be ventilated, with fan forced cooling where necessary. Cooling fans shall be impedance protected and ball bearing construction for continuous use.
 - b) NEMA 3R enclosed units shall be either ventilated or provided with an external enclosure and any necessary cooling accessories as determined by the manufacturer, depending on sizing, to meet the ambient operating conditions as indicated elsewhere.
 - c) 4/12 enclosed units shall be sealed to prevent ingress of contaminants and supplied with any necessary cooling accessories as determined by the manufacturer, to meet the ambient operating conditions as indicated elsewhere.
 - d) Power Terminations shall be made on factory supplied mechanical lugs of sufficient size to accommodate the required wire for the line and load. Lugs are to be clearly marked as Line (L1, L2, L3) and Load (T1, T2, T3) and with appropriate tightening torque specifications.

Control Terminations to the soft start main unit shall be on terminal strips that can be removed easily without the need to special tools.

Part 3 - Execution

Installation

The Contractor shall install all equipment in accordance with the contract Plans and manufacturers recommendations and manuals.

1. Install enclosed controllers where indicated, in accordance with manufacturer's instructions.
2. Install fuses in fusible switches.
3. Select and install overload heater elements in motor controllers to match installed motor characteristics.
4. The FLA motor amps shall be input into the starter memory via the keypad
5. Adjust all circuit breakers, switches, access doors and operating handles for free mechanical and electrical operation as described in manufacturer's instructions.
6. Clean interiors of all enclosed electrical equipment to remove construction debris, dirt and shipping materials.
7. Repaint scratched or marred exterior surfaces to match original finish.

Factory Testing

The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of UL and NEMA standards.

1. All printed circuit boards shall be functionally tested via fault finder bench equipment prior to unit installation.
2. All final assemblies shall be load tested.

Field Quality Control

Provide the services of a qualified factory-trained manufacturer's representative to assist the Contractor in installation and start-up of the equipment specified under this section. The manufacturer's representative shall provide technical direction and assistance to the Contractor in general assembly of the equipment, connections, adjustments, tuning of the system operation, and testing of the assembly and components contained herein.

The following minimum work shall be performed by the Contractor under the technical direction of the manufacturer's service representative.

1. Inspection and final adjustment.
2. Check proper operation and function of controllers/starters and spare parts.

Field Testing

A qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted, and tested in accordance with the manufacturer's recommendations.

The Contractor shall provide three (3) copies of the manufacturer's field start-up report before final payment is made.

Training

A qualified factory-trained manufacturer's representative shall provide a quantity of (1) two-hour session of on-site training instruction.

The instruction shall include the operational and maintenance requirements of the motor controller.

The basis of the training shall be the installed controller, the engineered drawings and the user manual. At a minimum, the training shall:

1. Review of the engineered drawings identifying the components shown on the Plans.
2. Review starting/stopping options of the controller.
3. Review the pump control option of the controller.
4. Review the maintenance requirements of the controller.
5. Review operation of the Human Interface for programming and monitoring the controller.
6. Review safety concerns with operating the controller.

16.45 Variable Frequency Drive

[CSI 26 29 23]

Part 1 - General

Summary

The Variable Frequency Drive (VFD) system shall contain all components required to meet the performance, protection, safety, and certification criteria of this specification.

Related Sections

- Division 16.30 Basic Panel Equipment and Devices
- Division 16.41 Motor Control Center
- Division 17 Automatic Control

References

- National Fire Protection Association - NFPA 70 - US National Electrical Code.
- National Electrical Manufacturers Association - NEMA 250 - Enclosures for Electrical Equipment.
- Underwriters Laboratory Inc. – UL 508.
- Canadian Standards Association International – CAN/CSA-C22.2 No. 14-05.
- International Electrical Code - IEC 146.
- Institute of Electrical and Electronics Engineers, Inc. - IEEE 519 - IEEE Standard Practices and Requirements for Harmonic Control in Electrical Power Systems.
- Seismic Standards ASCE 7-10, IBC, CBC, ICC_ESAC156, IEEE 693 and California OSHPD.

Submittals

Submit under provisions of Sections 1.33 and 16.05.

Shop Drawings - Approval

1. Elevation Drawings: Include dimensional information and conduit routing locations.
2. Unit Descriptions: Include amperage ratings, enclosure ratings, fault ratings, nameplate information, and so on, as required for approval.
3. Wiring Diagrams:
 - a) Power Diagram: Include amperage ratings, circuit breaker frame sizes, circuit breaker continuous amp ratings, and so on, as required for approval.
 - b) Control Diagram: Include disconnect devices, pilot devices, and so on.
4. Major components list.

Product Data Sheets

1. VFD and Operator Interface publications.
2. Data sheets and publications on all major components including, but not limited to, the following:
 - a) Contactors
 - b) Circuit breaker and fuse (power and control)
 - c) Control power transformers
 - d) Pilot devices
 - e) Relays/Timers

Test procedures shall be per the manufacturer's standards.

Closeout Submittals (Operation and Maintenance Manuals)

Submit under provisions of Sections 1.79.2 and 17.94.

Shop Drawings – Final as shipped

1. Elevation Drawings: Include dimensional information and conduit routing locations.
2. Unit Descriptions: Include amperage ratings, enclosure ratings, fault ratings, nameplate information, and so on, as required for approval.
3. Wiring Diagrams:
 - a) Power Diagram: Include amperage ratings, circuit breaker frame sizes, circuit breaker continuous amp ratings, and so on, as required for approval.
 - b) Control Diagram: Include disconnect devices, pilot devices, and so on.
 - c) Diagrams shall updated based on field modifications and shall be accurate depicting point-to-point wiring.
4. Major components list.

Product Data Sheets

1. VFD and Operator Interface publications.
2. Data sheets and publications on all major components including, but not limited to, the following:
 - a) Contactors
 - b) Circuit breaker and fuse (power and control)
 - c) Control power transformers
 - d) Pilot devices
 - e) Relays/Timers

Test procedures shall be per the manufacturer's standards.

Operation and Maintenance Data

1. Service and Contact information
2. VFD and Operator Interface User Manuals
3. Troubleshooting / Service Manuals

Quality Assurance

Qualifications:

1. Manufacturers:
 - a) The VFD and all associated optional equipment shall be UL listed or recognized.
 - b) The VFD shall contain a UL label attached on the inside of the enclosure cabinet.
2. Suppliers:
 - a) All inspection and testing procedures shall be developed and controlled under the guidelines of the Supplier's quality system and must be registered to ISO 9001 and regularly reviewed and audited by a third-party registrar.
 - b) The VFD shall be factory pre-wired, assembled and tested as a complete package.

Delivery, Storage, and Handling

Contractor shall coordinate the shipping of equipment with the manufacturer.

Contactors shall store the equipment in a clean and dry space at an ambient temperature range of -25 degrees Celsius to 55 degrees Celsius (-13 degrees Fahrenheit to 130 degrees Fahrenheit).

The Contractor shall protect the units from dirt, water, construction debris, and traffic.

Design Requirements

Drive(s) shall be of the size, capacity and quantity as shown on the Plans. VFD supplier shall confirm motor HP, amperage, service factor and operating requirements with motor supplier.

The VFD motor controller shall convert 480 Volt, 3-phase, 60 Hertz utility power to adjustable voltage (0 - 460V) and frequency (0 - 60 Hz.) 3-phase, AC power for stepless motor speed control with a capability of 10:1 speed range. All general options and modifications shall mount within the standard adjustable frequency controller enclosure.

The controller(s) shall be suitable for use with any standard NEMA-B squirrel-cage induction motor(s) having a 1.15 Service factor. At any time in the future, it shall be possible to substitute any standard motor (equivalent horsepower, voltage, and current) in the field.

The variable frequency control shall operate satisfactorily when connected to a bus supplying other solid-state power conversion equipment which may be causing up to 10 percent total harmonic voltage distortion and commutation notches up to 36,500-volt microseconds, or when other VFDs are operated from the same bus. Manufacturers shall certify at submittal time that their equipment will function satisfactorily under these circumstances.

Individual or simultaneous operation of the VFDs shall not add more than 5 percent total harmonic current distortion to the normal bus, nor more than 10 percent while operating from standby generator per IEEE 519, 2014. Prior to project completion, the Contractor shall provide verification through both measurement and calculations that the system is compliant with IEEE 519, 2014.

Part 2 – Products

Manufacturers

The VFD shall be a Siemens Sinamics G120 model VFD with Profinet communication interface, no substitutions.

All drives shall be supplied by one manufacturer.

The VFD equipment shall be of the same manufacturer and supplier as the MCC as required for interface with the master control system to provide a totally integrated and operable system.

Manufactured Units

The variable frequency control shall include transient voltage suppression to allow reliable operation on a typical industrial or commercial power distribution system.

Hardware

1. Utilize diode bridge or SCR bridge on the input rectifier.
2. Utilize DC bus inductor on all six-pulse VFDs only.
3. Utilize switching logic power supply operating from the DC bus.
4. Incorporate phase to phase and phase to ground MOV protection on the AC input line.
5. Microprocessor based inverter logic shall be isolated from power circuits.
6. Utilize latest generation IGBT inverter section.
7. Battery receptacle for Lithium battery power to the Real Time Clock.
8. Additional DPI port for handheld and remote HIM options.

9. Dedicated Digital Input for hardware enable.
10. Conformal coated printed circular boards.
11. Informal coated printed circuit boards.
12. Optional onboard 24V DC Auxiliary Control Power Supply.

Control Logic

1. Ability to operate with motor disconnected when in V/Hz mode.
2. Provide a controlled shut down, when properly protected, with no component failure in the event of an output phase to phase or phase to ground short circuit. Provide annunciation of the fault condition.
3. Provide multiple programmable stop modes including Ramp, Coast, DC-Brake, Ramp-to-Hold, Fast Braking, and Current Limit Stop.
4. Provide multiple acceleration and deceleration rates.
5. Adjustable output frequency up to 650 Hz.
6. Ability to control outputs and manage status information locally within the VFD.
7. Ability to function stand-alone or complementary to supervisory control.
8. Ability to provide scaling, selector switches, or other data manipulations not already built into the VFD.

Motor Control Modes

1. Selectable Sensorless Vector, Flux Vector, V/Hz, and Adjustable Voltage Control modes selectable through programming.
2. The drive shall be supplied with a Start-up and Auto-tune mode.
3. The V/Hz mode shall be programmable for fan curve or full custom patterns.
4. Capable of Open Loop V/Hz.

Current Limit

1. Programmable current limit from 20 percent to 160 percent of rated output current.
2. Current limit shall be active for all drive states: accelerating, constant speed and decelerating.
3. The drive shall employ PI regulation with an adjustable gain for smooth transition in and out of current limit.

Acceleration / Deceleration

1. Accel/Decel settings shall provide separate adjustments to allow either setting to be adjusted from 0 to 3600 seconds.
2. A second set of remotely selectable accel/decel settings shall be accessible through digital inputs.

3. S Curve profiles shall be adjustable.

Adjustments

1. A digital interface can be used for all set-up, operation and adjustment settings.
2. All adjustments shall be stored in nonvolatile memory (EEPROM).
3. No potentiometer adjustments shall be required.
4. EEPROM memory for factory default values shall be provided.
5. Software must be available for trending and diagnostics, as well as online and offline programming functionality.

Process PID Control

1. The drive shall incorporate an internal process PI regulator with proportional and integral gain adjustments as well as error inversion and output clamping functions.
2. The feedback shall be configurable for normal or square root functions. If the feedback indicates that the process is moving away from the set-point, the regulator shall adjust the drive output until the feedback equals the reference.
3. Process control shall be capable of being enabled or disabled with a hardwire input. Transitioning in and out of process control shall be capable of being tuned for faster response by preloading the integrator.
4. Protection shall be provided for a loss of feedback or reference signal.

Skip Frequencies

1. Three adjustable set points that lock out continuous operation at frequencies which may produce mechanical resonance shall be provided.
2. The set points shall have a bandwidth adjustable from Maximum Reverse Speed to Maximum Forward Speed.

Fault Memory

1. The last 100 fault codes shall be stored and time stamped in a fault buffer.
2. Information about the drive's condition at the time of the last fault such as operating frequency, output current, dc bus voltage and twenty-seven other status conditions shall be stored.
3. A power-up marker shall be provided at each power-up time to aid in analyzing fault data.
4. The last 100 alarm codes shall be stored and time stamped for additional troubleshooting reference.

Fault Reset / Run

1. The drive shall provide up to nine automatic fault reset and restarts following a fault condition before locking out and requiring manual restart.
2. The automatic mode shall not be applicable to a ground fault, shorted output faults and other internal microprocessor faults.

3. The time between restarts shall be adjustable from 0.5 seconds to 30 seconds.

Run on Power Up

1. A user programmable restart function shall be provided to allow restart of the equipment after restoration of power after long duration power outages. Restart time dependent on presence of incoming signal.

Overload Protection

1. The drive shall provide internal class 10 adjustable overload protection.
2. Overload protection shall be speed sensitive and adjustable.
3. A viewable parameter shall store the overload usage.

Auto Economizer

1. An auto economizer feature shall be available to automatically reduce the output voltage when the drive is operating in an idle mode (drive output current less than programmed motor FLA). The voltage shall be reduced to minimize flux current in a lightly loaded motor thus reducing kW usage.
2. When the load increases, the drive shall automatically return to normal operation.

Terminal Blocks

1. Separate terminal blocks shall be provided for control and power wiring.
2. I/O terminal blocks shall be removable with wiring in place.
3. For frames 8 to 10 power wiring is landed on robust L-brackets behind the drive unit. This wiring remains in-place if the drive unit is removed.

Flying Start

1. The drive shall be capable of determining the speed and direction of a spinning motor and adjust its output to "pick-up" the motor at the rotating speed. This feature is disabled by default.

Inputs and Outputs

1. The Input / Output option modules shall consist of both analog and digital I/O.
2. No jumpers or switches shall be required to configure digital inputs and outputs.
3. All digital input and output functions shall be fully programmable.
4. The control terminal blocks shall be rated for 115V AC.
5. Inputs shall be optically isolated from the drive control logic.
6. The control interface card shall provide input terminals for access to fixed drive functions that include start, stop, external fault, speed, and enable.

7. The VFD shall be capable of supporting up to 7 analog inputs, 7 analog outputs, 21 digital inputs, 7 relay outputs, 7 transistor outputs, and 3 positive temperature coefficient (PTC) inputs.
8. The Input / Output option modules shall have the following features:
 - a) Analog Inputs:
 - i. Quantity two (2) differentially isolated, $\pm 10\text{V}$ (bi-polar), 88k ohm input impedance, 4-20 mA, 11 bit plus sign.
 - ii. Analog inputs shall be user programmable for a variety of uses including frequency command and process loop input. Analog inputs shall be user programmable for function scaling (including invert), offset, signal loss detect, and square root.
 - b) Analog Outputs:
 - i. Quantity two (2) $\pm 10\text{V}$ (bi-polar) / 11 bit and sign, 2 k ohm minimum load, 4-20 mA, 11 bit plus sign, 400 ohm maximum load.
 - ii. The analog output shall be user programmable to be proportional to one of fourteen process parameters including output frequency, output current, encoder feedback, output power.
 - iii. Programming shall be available to select either absolute or signed values of these parameters.
 - c) Digital Inputs:
 - i. Quantity of six (6) digital inputs rated 24V DC/115V AC.
 - ii. All inputs shall be individually programmable for multiple functions including: Start, Run, Stop, Auxiliary Fault, Speed Select, Jog and Process PI functions.
 - d) Digital Outputs:
 - i. At least one (1) relay output (N.O. or N.C.).
 - ii. For 240V AC or 24V DC, N.O. contact output ratings shall be 2-amp maximum, general purpose (inductive)/resistive. N.C. contact output ratings shall be 2-amp maximum, resistive only.
 - iii. Relays shall be programmable to multiple conditions including: Fault, Alarm, At Speed, Drive Ready, and PI Excess Error.
 - iv. Timers shall be available for each output to control the amount of time, after the occurring event, that the output relay actually changes state.
 - v. At least one (1) transistor output.
 - vi. For 24V DC, transistor output rating shall be 1-amp maximum, Resistive.

Reference Signals

1. The drive shall be capable of using the following input reference signals:
 - a) Analog Inputs
 - b) Preset Speeds

- c) Remote Potentiometer
- d) Digital MOP
- e) Human Interface Module
- f) Communication Modules

Loss of Reference

1. The drive shall be capable of sensing reference loss conditions.
2. In the event of loss of the reference signal, the drive shall be user programmable to the following:
 - a) Fault the drive and coast to stop.
 - b) Issue a minor fault - allows the drive to continue running while some types of faults are present.
 - c) Alarm and maintain last reference.
3. When using a communications network to control the drive, the communications adapter shall have these configurable responses to network disruptions and controller idle (fault or program) conditions:
 - a) Fault
 - b) Stop
 - c) Zero Data
 - d) Hold Last State
 - e) Send Fault Configuration

Metering

1. At a minimum, the following parameters shall be accessible through the Human Interface Module, if installed:
 - a) Output Current in Amps
 - b) Output Voltage in Volts
 - c) Output Power in kW
 - d) Elapsed MWh
 - e) DC Bus Voltage
 - f) Frequency
 - g) Heatsink Temperature
 - h) Last eight (32) faults
 - i) Elapsed Run Time
 - j) IGBT Temperature
 - k) Blown fuses, including specific fuse locations communicated to the host system

Faults

1. At a minimum, the following faults shall be accessible through the Human Interface Module:
 - a) Power Loss
 - b) Undervoltage
 - c) Overvoltage
 - d) Motor Overload
 - e) Heat Sink Over-temperature
 - f) Maximum Retries
 - g) Phase to Phase and Phase to Ground Faults

Predictive Maintenance Features

1. At a minimum, the following predictive diagnostic features shall be provided, and a parameter showing the remaining lifetime expressed as hours of the following components will be available:
 - a) Relay Output Life Cycles based on load type and amps.
 - b) Hours of Fan Life based on load and ambient temperature.
 - c) Motor Bearing life based on expected hours of use.
 - d) Motor Lubrication schedule based on hours of use.
 - e) Machine Bearing life based on expected hours of use.
 - f) DC Bus Capacitors based on actual use (temperature, current, and ripple).
 - g) IGBTs based on actual load and temperature.
 - h) LCL filter Capacitors based on actual use.

Real-Time Clock

1. Shall be capable of providing time stamped events.
2. Shall have the ability to be set locally or via a remote controller.
3. Shall provide the ability to be programmable for month, day, year and local time zones in HH:MM:SS.

VFD Packaged System

Basic Features

1. Ratings
 - a) Voltage
 - i. Capable of accepting nominal power of 480V AC at 60 Hz.
 - ii. The supply input voltage tolerance shall be ± 10 percent of nominal line voltage.

- b) Displacement Power Factor
 - i. Six-pulse VFD shall be capable of maintaining a minimum true power factor (Displacement P.F. X Distortion P.F.) of 0.95 or better at rated load and nominal line voltage, over the entire speed range.
- c) Efficiency
 - i. A minimum of 96.5 percent (+/- 1 percent) at 100 percent speed and 100 percent motor load at nominal line voltage.
 - ii. Control power supplies, control circuits, and cooling fans shall be included in all loss calculations.
- d) Operating ambient temperature range without derating: 0 degrees Celsius to 40 degrees Celsius (32 degrees Fahrenheit to 104 degrees Fahrenheit).
- e) Operating relative humidity range shall be 5 percent to 95 percent non-condensing.
- f) Operating elevation shall be up to 1,000 Meters (3,300 ft) without derating.
- 2. Sizing
 - a) Systems rated at Normal Duty loads shall provide 110 percent overload capability for up to one minute and 150 percent for up to 3 seconds.
 - b) Systems rated at Heavy Duty loads shall provide 150 percent overload capability for up to one minute and 180 percent for up to 3 seconds.
- 3. Auto Reset/Run
 - a) For faults other than those caused by a loss of power or any other non-critical fault, the drive system shall provide a means to automatically clear the fault and resume operation.
- 4. Ride-Through
 - a) The VFD system shall attempt to ride through power dips up to 20 percent of nominal. The duration of ride-through shall be inversely proportional to load. For outages greater than 20 percent, the drive shall stop the motor and issue a power loss alarm signal to a process controller, which may be forwarded to an external alarm signaling device.
- 5. Run on Power Up
 - a) The VFD system shall provide circuitry to allow for remote restart of equipment after a power outage. Unless indicated in the contact drawings, faults due to power outages shall be remotely resettable. The VFD system shall indicate a loss of power to a process controller, which may be forwarded to an external alarm signaling device. Upon indication of power restoration the process controller will attempt to clear any faults and issue a run command, if desired.
- 6. Communications
 - a) VFD shall be capable of communicating on multiple networks.
 - b) The VFD shall provide a Profinet interface.

7. Enclosure Door Mounted Human Interface Module (HIM)
 - a) VFD shall provide a HIM with integral LCD display, operating keys and programming keys.
 - b) An enclosure door-mounted HIM, rated NEMA/UL Type 1, shall be provided
 - c) The HIM shall have the following features:
 - i. A seven (7) line by twenty-one (21) character backlit LCD display with graphics capability.
 - ii. Shall indicate drive operating conditions, adjustments, and fault indications.
 - iii. Shall be configured to display in the following three distinct zones:
 - a. The top zone shall display the status of direction, drive condition, fault / alarm conditions, and Auto / Manual mode.
 - b. The middle zone shall display drive output frequency.
 - c. The bottom zone shall be configurable as a display for either programming menus / information or as a two-line user display for two additional values utilizing scaled units.
 - iv. Shall provide digital speed control.
 - v. The keypad shall include programming keys, drive operating keys (Start, Stop, Direction, Jog, and Speed Control), and numeric keys for direct entry.

Enclosure

1. Shall be rated NEMA/UL Type (1)
2. Shall be painted per the manufacturer's standard.
3. Shall provide entry and exit locations for power cables.
4. Shall contain a label for UL508.
5. The drive system nameplate shall be marked with system Short Circuit Current Rating (SCCR).

Drive Enclosure Input Disconnect

1. Provide an enclosure door interlocked disconnect with thermal magnet circuit breaker.
2. Operator Handles
 - a) Provide externally operated main disconnect handle.
 - b) Handles shall be lockable with up to three lockout / tagout padlock positions.

Branch Circuit Protection

1. Input inverse time circuit breaker shall be provided.

Control Power Transformer

1. Provide a control power transformer mounted and wired inside of the drive system enclosure.

2. The transformer shall be rated for the VFD power requirements.

Harmonic Mitigation Techniques

1. The drive system shall be compliant with IEEE 519-2014 standards at the input VFD terminals based upon the input power phase imbalance within 0.5 percent of nominal line voltage and under full VFD output current ratings
2. Drive Input Line Reactor
 - a) Provide a drive input line reactor mounted within the drive system enclosure.
 - b) The line reactor shall meet the following specifications:
 - i. The construction shall be iron core with an impedance of 5 percent.
 - ii. The winding shall be copper or aluminum wound.
 - iii. The insulation shall be Class H with a 115 degrees Celsius rise over 50 degrees Celsius ambient.
 - iv. The unit shall be rated for system voltage, ampacity, and frequency.
3. Passive Harmonic Filter
 - a) VFDs shown with passive harmonic line filters shall be supplied with an input AC line harmonic filter compensated reactor with minimum 5 percent impedance unless noted otherwise on the one-line diagram. Line reactor shall be designed to address performance issues of NEMA MG1-20.55 and to provide proper transient protection of the VFD input power devices. Harmonic line filters shall be MTE Matrix Series AP Harmonic Filters or equal, with Capacitor Contactor for disconnecting the filter capacitor bank when the drive is not running.

Auxiliary Relays

1. Provide relays for Drive Alarm, Drive Ready, Drive Fault, Drive Run, and System Status Faults (as required).
2. See section 16.32.1 Relays.

Control Interface

1. The control terminals shall be rated for 115V AC.
2. The control interface shall provide input terminals for access to VFD functions that include start, stop, external fault, speed select, and enable, as required.

Hand/Off/Auto Selector Switch

1. Provide a "HAND/OFF/AUTO" selector switch, mounted on the enclosure door.
2. The "HAND/OFF/AUTO" selector switch shall start the drive in the "HAND" mode and stop the drive in the "OFF" mode.
3. In the "AUTO" mode the drive shall be started and stopped from a remote "RUN" contact.
4. In all modes, Auxiliary and Enable inputs to the drive control interface board must be present before the drive will start.

5. When a HIM is present, the stop function shall always be available to stop the drive regardless of the selected mode (“HAND” or “AUTO”). The HIM will be non-functional (except for the display and programming) when the switch is in “OFF” mode. The HIM shall stop the drive if the switch is in the “AUTO” mode with the remote start contact initiated.
6. The drive speed reference shall be controlled from the HIM, unless a separate door-mounted potentiometer is provided, when in “HAND” mode (factory default setting).
7. The drive speed reference shall be controlled by a remote 4...20 mA input when in “AUTO” mode.
8. See section 16.31.5 Selector Switch.

Drive Disable Mushroom Push Button

1. Provide a maintained mushroom style push button, mounted on the enclosure door that when pushed, will open the drive enable input.
2. See section 16.31.4 Pushbuttons.

Pilot Lights

1. Provide LED pilot lights, mounted on the enclosure door, for indication of the following status:
 - a) Run
 - b) Drive Fault
 - c) Control Power On
 - d) Motor Fault
2. See section 16.31.6 Indicating Lights.

Motor Run Time Meter

1. Provide a digital, non-resettable, door-mounted elapsed time meter.
2. The meter shall be electrically interlocked with the Drive Run relay and Bypass contactor to indicate actual motor operating hours.
3. See section 16.31.2 Run Time Meters.

Output Filtering

1. 5 percent output line reactor

Part 3 – Execution

Setup

VFD Manufacturer shall program:

1. All fault settings to reset after fault condition returns to normal
2. Minimum and maximum motor speeds provided by motor manufacturer.
3. Hertz change per second.

4. Hand speed control shall be set to 95 percent of full range for panel mounted HOA switch.
5. Profinet and HIM module communication faults/alarms to “No Action”. Communication errors should not shut down the VFD.

Examination

Verify that location is ready to receive equipment.

Verify that the building environment can be maintained within the service conditions required by the manufacturer of the VFD.

Testing

This equipment shall be tested and placed into operation by a qualified factory representative trained in start-up and troubleshooting procedures for equipment being installed.

All components shall be factory tested both by the manufacturer at the manufacturer's facility and in the presence of the Engineer by the manufacturer or manufacturer's representative at the manufacturer's facility or at a Control System Integrator's shop located within 100 miles of the job site. Factory testing shall be witnessed by the Engineer. If factory witness testing is to occur at the manufacturer's facility, the manufacturer's facility where testing takes place shall be located within the United States of America. Shipment of VFD to the job site shall not be allowed until the Engineer has witnessed factory testing and approved the VFD for shipment to the job site.

Installation

Installation shall be in compliance with all manufacturer requirements, instructions, and drawings.

Startup

At a minimum, the start-up service shall include:

1. Perform pre-Power Check
2. Megger Motor Resistances: Phase-to-Phase and Phase-to-Ground
3. Verify system grounding per manufacturer's specifications
4. Verify power and signal grounds
5. Check connections
6. Check environment

Drive Power-up and Commissioning:

1. Measure Incoming Power Phase-to-Phase and Phase-to-Ground
2. Measure DC Bus Voltage
3. Measure AC Current Unloaded and Loaded
4. Measure Output Voltage Phase-to-Phase and Phase-to-Ground
5. Verify input reference signal

All measurements shall be recorded.

Drive shall be tuned for system operation.

Drive parameter listing shall be provided.

The line side converter shall be configured and tuned for the local input power conditions.

The motor side inverter shall be tuned for system operation.

Training

Manufacturer to provide a quantity of one 4-hour sessions of on-site instruction.

The instruction shall include the operational and maintenance requirements of the variable frequency drive.

The basis of the training shall be the variable frequency drive, the engineered drawings and the user manual. At a minimum, the training shall:

1. Review the engineered drawings identifying the components shown on the drawings.
2. Review starting / stopping and speed control options for the controller.
3. Review operation of the HIM for programming and monitoring of the variable frequency drive.
4. Review the maintenance requirements of the variable frequency drive.
5. Review safety concerns with operating the variable frequency drive.

16.50 PANELBOARDS

[CSI 26 24 00]

16.52 Panelboards

[CSI 26 24 16]

Part 1 - General

Description of Work

This section covers the furnishing and installation of all panelboard equipment complete.

Quality Assurance

Provide products specified in this Section that are listed and labeled as defined in NEC Article 100.

Standards and Codes

All materials and equipment specified herein shall, within the scope of UL Examination Services, be approved by the Underwriter's Laboratories for the purpose for which they are used and shall bear the UL label.

All material and equipment specified herein shall conform with all applicable NEMA, ANSI, and IEEE standards.

All materials and equipment specified herein, and their installation methods shall conform to the latest published version of the NEC.

Part 2 – Products

Manufacturers

Materials, equipment, and accessories specified in this section shall be products of:

- Eaton/Cutler-Hammer
- Schneider Electric/Square D Company
- Siemens

Panelboards shall be of the same manufacturer as equipment furnished under Section 16.50, Low Voltage Motor Control.

Components

Panelboard Type

1. Panelboards shall be rated at proper voltage and current for intended use with bus bars of copper. Panels shall be 3-phase, 4-wire, 100 percent neutral, with equipment ground bar unless noted otherwise. Panelboards shall be dead front.

Wire Terminations

1. Panelboard assemblies, including protective devices, shall be suitable for use with 75 degrees Celsius or greater wire insulation systems at NEC 75 degrees Celsius conductor ampacity in accordance with UL 486E.

Load Current Ratings

1. Unless otherwise indicated, load current ratings for panelboard assemblies, including bus and circuit breakers, are non-continuous as defined by NEC. Continuous rating shall be 80 percent of non-continuous rating.
2. Where indicated “continuous”, “100 percent”, etc., selected components and protective devices shall be rated for continuous load value shown.
3. The following interrupting capacity shall be considered minimum. Other ratings shall be as specified on the Plans.

240V and 208Y/120V Panelboards	22,000 AIC symmetrical
480V/277V Panelboards	40,000 AIC symmetrical

Overcurrent Protective Devices

1. In accordance with NEMA AB 1, NEMA KS 1, UL 98 and UL 489, protective devices shall be adapted to panelboard installation.
2. Panelboards shall be capable of device replacement without disturbing adjacent devices and without removing main bus.
3. Spare Spaces: Cover openings with easily removable cover.

4. When not identified on Plans, provide minimum of 18 single-pole breaker spaces.

Circuit Breakers

1. Provide thermal-magnetic unless otherwise indicated, quick-make, quick-break, molded case, of indicating type showing ON/OFF and TRIPPED positions of operating handle. Mount breakers in all panelboards so that the breaker handles operate in a horizontal plan.
2. The bus connection shall be bolt-on circuit breakers in all panelboards. In power distribution panelboards, 225-ampere frame sizes and greater may be plug-in type where individual positive locking device requires mechanical release for removal.
3. Trip Mechanism:
 - a) Individual permanent thermal and magnetic trip elements in each pole.
 - b) Test button on cover.
 - c) Variable magnetic trip elements with a single continuous adjustment 3X to 10X for frames greater than 100 amps.
 - d) Two and three pole breakers shall have common trip.
 - e) Automatic opens all poles when overcurrent occurs on one pole.
 - f) Calibrated for 40 degrees C ambient, unless shown otherwise.

Ground Fault Circuit Interrupter (GFCI)

1. Where indicated, equip breaker as specified above with ground fault sensor rated to trip on 5-mA ground fault with 0.025 second (UL 943, class A sensitivity, for protection for personnel).
2. Ground fault sensor shall be rated same as circuit breaker.
3. GFCI shall have a push-to-test button and a reset button.

Equipment Ground Fault Interrupter (EGFI)

1. Where indicated, equip breaker as specified above with ground fault sensor rated to trip on 30-mA ground fault (UL listed for equipment ground fault protection).

Cabinets for Each Panelboard

1. Cabinets shall be flush, or surface mounted as indicated on the Plans with tight closing doors without play when latched. Where two cabinets are located adjacent to each other in finished areas, provide matching trim of the same height.
2. Provide cabinets of sufficient dimensions to allow for future expansion and addition of circuit breakers within the panelboards as indicated on the Plans.
3. Provide locks for each cabinet door. All electrical distribution equipment locks are to be keyed identically.
4. Fasten panelboard with machine screws with oval countersunk heads, finish hardware quality, with escutcheons or approved trim clamps. Clamps assessable only when dead front door is open are acceptable. Surface mounted panelboards with fronts greater than

48 inches vertical dimension shall have trim hinged at the right side in addition to the hinged door over dead front.

5. Material for Type 1, Type 3R, and Type 3S cabinets shall be code-gauge, hot-dip galvanized sheet steel with reinforced steel frame.
6. Finish all enclosures with rust inhibitor primer followed by manufacturer's standard gray baked enamel or lacquer.

Bus

1. Material for internal bus shall be full size copper throughout length. Provide for mounting of future protective devices along full length of bus regardless of number of units and spaces shown. Machine, drill and tap as required for current and future positions.

Feeder Lugs

1. Main and neutral feeder lugs shall be replaceable, bolted mechanical or crimp compression type.

Equipment Ground Terminal Bus

1. Provide copper equipment ground terminal bus with suitably sized provisions for termination of ground conductors. The terminal bus shall be bonded to the enclosure.
2. Provide individual mechanical termination points no less than the quantity of breaker pole positions.
3. Provide individual termination points for all other grounding conductors such as feeder, grounding electrodes, etc.

Neutral Terminal Bus

1. Provide copper neutral terminal bus with suitably sized provisions for termination of neutral conductors. The neutral bus shall be isolated from the enclosure.
2. Provide individual mechanical termination points no less than the quantity of breaker pole positions.
3. Provide individual termination points for all other neutral conductors.
4. Termination points shall be bolted crimp compression lugs for conductors 6 AWG or larger.

Part 3 – Execution

General

Install in accordance with NECA 407, NEMP PB 1.2 and manufacturers' written installation instructions.

Installation

Install securely, plumb, in-line and square with walls.

Install top of panelboard trim 72 inches above floor, unless otherwise shown. Install panelboard so tops of protective device operating handles are no more than 72 inches above the floor.

Install filler plates in unused spaces.

System of Numbering and Bus Arrangement

System numbering and bus arrangement shall be as shown on the panel schedule on the Plans.

Panelboard Nameplate

Provide engraved plastic nameplate with 1/2-inch high characters for panel identifications (for panel name) attached with screws to each panelboard front. Include voltage, phase and wire (i.e., 208Y/120, 3-phase, 4-wire) in 3/8-inch characters.

Circuit Index

Provide as-built information for each branch circuit panelboard by circuit with its proper load designation.

Ground Fault Protection

Install panelboard ground fault circuit interrupter devices in accordance with installation guidelines of NEMA 289.

16.55 Switches and Protective Devices

[CSI 26 18 00 (medium voltage) 26 28 00 (low voltage)]

16.55.1 Common Work for Switches and Protective Devices

[CSI 26 18 05, 26 28 05]

Part 1 - General

Design Requirements

Overcurrent devices shall be NEMA rated.

Extra Materials

Provide one fuse for each ungrounded conductor and a minimum of one spare fuse per phase of each ampacity and voltage used on the project. Deliver fuses to Owner at the completion of the project.

Part 3 – Execution

Installation

Overcurrent protection devices and safety switches shall be centered 60 inches above the finished floor unless noted otherwise on the Plans.

16.55.13 Fuses

[CSI 26 18 16, 26 28 13]

Part 1 - General

Design Requirements

Fuses shall be of the type and amperage indicated on the Plans. The voltage rating shall be appropriate for the application indicated. The fuse types indicated on the Plans imply a certain set of fuse characteristics. No substitutions of fuse types will be allowed without Engineer approval.

Part 2 - Products

Manufacturers

Fuses shall be:

- Bussman,
- Gould Shawmut
- Littlefuse
- Reliance
- Or Equal

Materials

Fuses in motor circuits which are indicated but not sized, shall be provided with Manufacturer's recommended size based on the actual motor installed. In-line or integrally-mounted fuse clips shall be provided on all control power or low-voltage transformers.

16.55.16 Molded Case Circuit Breakers

[CSI 26 28 16.14]

Part 1 - General

Design Requirements

Breakers shall have the interrupting rating and trip rating indicated on the Plans. All breakers shall be calibrated for operation in an ambient temperature of 40 degrees Celsius.

Part 2 - Products

Manufactured Units

Molded case circuit breakers shall be quick-make and quick-break type with wiping type contacts. Each breaker shall be provided with arc chutes and individual trip mechanisms on each pole consisting of both thermal and magnetic trip elements. Two and three pole breakers shall be common trip. Molded case circuit breakers shall be trip-free. Each breaker shall have trip indication independent of the "ON" or "OFF" positions.

16.55.17 Instantaneous Magnetic Trip Breakers

[CSI 26 28 16.15]

Part 1 - General

Design Requirements

The magnetic trips shall be adjustable and accessible from the front of all these breakers.

Part 2 - Products

Manufactured Units

Breakers in motor circuits which are indicated but not sized, shall be provided with Manufacturer's recommended size based on the actual motor installed. Where indicated on the Plans and in the combination motor starter/motor control center schedule, furnish instantaneous magnetic trip only circuit breakers for motor short circuit protection.

16.55.18 Disconnect Switches

[CSI 26 28 16.17]

Part 1 - General

Design Requirements

Furnish and install disconnect switches conforming to NEMA KS 1, type HD, sized for the ampere and voltage as shown on the Plans and as required by the NEC and nameplate requirements of the equipment served.

Part 2 - Products

Manufactured Units

The switches shall be 600-volt type and horsepower rated. Auxiliary contacts shall be provided as indicated on the Plans.

Part 3 – Execution

Installation

Provide additional disconnects if required by Code.

16.60 CONDUCTORS

16.61 Low Voltage Wire and Cable

[CSI 26 05 19]

Part 1 - General

Design Requirements

This section is for power and control conductors for 600 volts or less.

All conductors shall be copper. Wire or cable not shown on the Plans or specified, but required, shall be of the type and size required for the application and in conformance with the applicable code.

Part 2 - Products

Materials

Conductors

1. Solid and stranded copper wire shall be 600-volt Type THW, THWN, or THHW, Class B stranding, sizes #14 AWG, #12 AWG, and #10 AWG only. Use of THHN insulation shall not be allowed. Aluminum conductors shall not be allowed.
2. Stranded copper wire shall be 600-volt Type XHHW, Class B stranding, sizes #8 AWG and larger. Aluminum conductors shall not be allowed.

Splices

1. For Lighting Systems and Power Outlets: Wire nuts shall be twist-on type insulated connectors utilizing an outer insulating cover and a means for connecting and holding the conductors firmly.
2. All Equipment: Crimp type connectors shall be insulated type, suitable for the size and material of the wires and the number of wires to be spliced and for use with either solid or stranded conductors.
3. Division 16 Equipment and Power Conductors: Bolted pressure connectors shall be suitable for the size and material of the conductors to be spliced.
4. All Equipment: Epoxy splice kits shall include epoxy resin, hardener, mold, and shall be suitable for use in wet and hazardous locations.

Terminations

1. Crimp type terminals shall be self-insulating sleeve type, with ring or rectangular type tongue, suitable for the size and material of the wire to be terminated, and for use with either solid or stranded conductors.
2. Terminal lugs shall be split bolt or bolted split sleeve type in which the bolt or set screw does not bear directly on the conductor.
3. Wire Markers shall be plastic sleeve type. Wire numbers shall be permanently imprinted on the markers.

Finishes

Color Coding: Provide color coding for all circuit conductors. Insulation color shall be white for neutrals and green for grounding conductors. An isolated ground conductor shall be identified with an orange tracer in the green body. Ungrounded conductor colors shall be as follows:

1. 120/208 Volt, 3 Phase: Red, black and blue.
2. 277/480 Volt, 3 Phase: Yellow, brown and orange.
3. 120/240 Volt, 1 Phase: Red and black.

Part 3 – Execution

Location (Installment) Schedule

Provide the following conductors for the following applications:

1. Use stranded copper conductors for all power and control circuits unless noted otherwise on plans or below. Size as noted on the Plans.
2. Contractor may use solid copper conductors for lighting and receptacle circuits using screw-type terminals. Size as noted on the Plans.
3. Size #14 AWG wire or smaller shall not be allowed on power circuits.

Installation

Conductor Splices

1. Splices: Install all conductors without splices unless necessary for installation, as determined by the Engineer. Splices when permitted shall be completed using an approved splice kit intended for the type of conductor and the application. The splice shall be in accordance with the splice kit manufacturer's instructions.
2. Underground Splices: All underground outdoor splices when approved by Engineer shall be completed in an accessible pullbox or handhole using an approved watertight epoxy resin splice kit rated for the application up to 600 volts. Splices will not be allowed to be direct buried.

Conductor Identification

1. Except for interior lighting and receptacle circuits, identify each wire or cable at each termination and in each pullbox, junction box, handhole, and manhole using numbered and lettered wire markers. All electrically common conductors shall have the same number. Each electrically different conductor shall be uniquely numbered. Identify panelboard circuits using the panelboard identification and circuit number. Identify motor control circuits using the equipment identification number assigned to the control unit by the motor control center manufacturer and the motor control unit terminal number. Identify other circuits as shown in the circuit schedule as favorably by the Engineer.
2. Conductors between terminals of different numbers shall have both terminal numbers shown at each conductor end. The terminal number closest to the end of the wire shall be the same as the terminal number.

Testing

Insulation Resistance Tests: For all circuits 150 volts to ground or more and for all motor circuits over ½ horsepower, test cables per NETA Paragraph 7.3.1. The insulation resistance shall be 20 megohms or more. Submit results to Engineer for review.

16.63 Signal Cable

[CSI 27 15 00]

Part 2 - Products

Materials

Twisted Shielded Pairs (TSP)

1. Cable shall conform to IEEE 383, UL 13, and UL 83 and shall be type PLTC cable suitable for direct burial. Each TSP shall consist of two #16 AWG, 7-strand copper conductors per ASTM B8 with 15 Mils PVC insulation and individual conductor jacket of nylon. Conductors shall be twisted with 2-inch or shorter lay, with 100 percent foil shielding and tinned copper drain wires. The cable shall have an overall PVC jacket with a thickness of 35 Mils. The insulation system shall be rated at 90 degrees Celsius and for operation at 600 volts.

Cat 5E Ethernet Cable

1. The Ethernet cable shall be shielded 600V UL rated. The use of a 300V rated cable is not acceptable. All Ethernet cable terminating outside of a telemetry panel shall be grounded at the telemetry panel only.
2. Ethernet cables shall be industrial type Ethernet cable and UL listed for installation in the Motor Control Center. Ethernet cables shall be Allen-Bradley Ethernet Cable with metal In-cabinet RJ45 Connectors, or equal.

Part 3 - Execution

Installation

Cable Installation

1. Cables shall be continuous from initiation to termination without splices.
2. Cable shielding shall be grounded at one end of the cable only. Bonding shall be to a single ground point only. Bonding from cable to cable in multiple run installations shall not be permitted.
3. Install instrumentation cables in separate raceway systems with voltages not to exceed 30 volts DC.

Conductor Identification

1. Except for interior lighting and receptacle circuits, identify each wire or cable at each termination and in each pullbox, junction box, handhole, and manhole using numbered and lettered wire markers. All electrically common conductors shall have the same number. Each electrically different conductor shall be uniquely numbered. Identify panelboard circuits using the panelboard identification and circuit number. Identify motor control circuits using the equipment identification number assigned to the control unit by the motor control center manufacturer and the motor control unit terminal number. Identify other circuits as shown in the circuit schedule as determined by the Engineer.

2. Conductors between terminals of different numbers shall have both terminal numbers shown at each conductor end. The terminal number closest to the end of the wire shall be the same as the terminal number.

Testing

Insulation Resistance Tests: Perform insulation resistance on all circuits. Make these tests before any equipment has been connected. Test the insulation with a 500 Vdc insulation resistance tester with a scale reading 100 mega ohms. The insulation resistance shall be 20 mega ohms or more. Submit results to Engineer for review.

16.70 RACEWAYS, BOXES, AND FITTINGS

[CSI 26 05 33]

16.71 Raceways

[CSI 26 05 33.23]

Part 1 – General

Design Requirements

Conduit sizes not noted on Plans shall be in accordance with NEC requirements for the quantities and sizes of wire installed therein.

Part 2 – Products

Components

Conduit and Fittings

1. Galvanized Rigid Steel (GRS): Rigid conduit shall be steel, hot dipped galvanized inside and out. The GRS must meet USA Standards Institute C80-1 Underwriters Laboratories Standard UL6 and carry a UL label. Use cast threaded hub fittings and junction boxes for all rigid conduit except in locations not permitted by the NEC.
2. PVC Coated Rigid Steel Conduit (PVC-GRS): PVC coated conduit shall meet the GRS standard above plus have a 40 Mil PVC factory applied PVC coating.
3. Nonmetallic Conduit: Nonmetallic Conduit shall be rigid PVC, Schedule 40 (PVC-40) or 80 (PVC-80). PVC conduit installed above grade shall be Schedule 80 extra heavy wall 90 degree Celsius. UL listed for aboveground use and UV resistant. Conduit shall be gray in color. Fittings shall be of the same material as the raceway and installed with solvent per the Manufacturer's instructions. Conduit, fittings, and solvent shall all be manufactured by the same Manufacturer.
4. Flexible Metal Conduit (Flex-LT): Flexible conduit shall be interlocking single strip, hot dipped galvanized and shall have a polyvinyl chloride jacket extruded over the outside to form a flexible watertight raceway. Flexible conduit shall be American Brass Company Sealtite Type VA, General Electric Type UA or equal.

5. Electrical Metallic Tubing (EMT): EMT shall be UL 797 and ANSI C80.3; steel tubing, hot dipped galvanized. EMT fittings shall be ANSI/NEMA FB 1; steel, rain tight, insulated throat, compression type.

Conduit and Cable Supports

1. Conduit Supports: Hot dipped galvanized framing channel shall be used to support groups of conduit. Individual conduit supports shall be one-hole galvanized malleable iron pipe straps used with galvanized clamp backs and nesting backs where required. Conduit support for PVC or PVC coated rigid steel shall be one-hole PVC or epoxy coated clamps or PVC conduit wall hangers.
2. Ceiling Hangers: Ceiling hangers shall be adjustable galvanized carbon steel rod hangers. Unless otherwise specified, hanger rods shall be 1/2-inch all-thread rod and shall meet ASTM A193. Hanger rods in corrosive areas and those exposed to weather or moisture shall be stainless steel.

Conduit Sealants

1. Moisture Barrier Types: Sealant shall be a non-toxic, non-shrink, non-hardening, putty type hand applied material providing an effective barrier under submerged conditions.
2. Fire Retardant Types: Fire stop material shall be a reusable, non-toxic, asbestos-free, expanding, putty type material with a 3-hour rating in accordance with UL 1479. Provide products indicated by the manufacturer to be suitable for the type and size of penetration.

Part 3 - Installation

Raceway Applications

Galvanized Rigid Steel (GRS) conduit shall be used in all locations unless noted otherwise below or on the Plans.

ABOVE GRADE CONDUITS (non-corrosive areas) shall be:

1. GRS for power and control wiring.
2. GRS for instrumentation and telecommunications wiring.
3. GRS for motor leads from VFDs.
4. EMT for above-grade lighting circuits.

ABOVE GRADE CONDUITS (wet or corrosive areas, NFPA 70 hazardous areas) shall be:

1. PVC-GRS for power and control wiring.
2. PVC-GRS for instrumentation and telecommunications wiring.
3. PVC-GRS for motor leads from VFDs.

CONCEALED ABOVE GRADE CONDUITS shall be:

1. GRS for all wire and cable types in wood stud frame walls.
2. PVC-40 for power and control wiring in concrete block or brick walls.

3. PVC-40 for instrumentation and telecommunications wiring in CMU or brick walls.
4. GRS for motor leads from VFDs in CMU or brick walls.

BELOW GRADE CONDUITS IN DIRECT EARTH (not under slabs-on-grade) shall be:

1. PVC-40 for power and control wiring.
 - a) Sweeps and risers for transition of PVC from below grade to above grade shall be PVC-GRS.
2. PVC-GRS for instrumentation and telecommunications wiring.
3. PVC-GRS for motor leads from VFDs.

UNDER SLABS-ON-GRADE CONDUIT shall be:

1. PVC-40 for power and control wiring
 - a) Sweeps and risers for transition of PVC from below grade to above grade shall be PVC-GRS.
2. PVC-GRS for instrumentation and telecommunications wiring.
3. PVC-GRS for motor leads from VFDs.

CONCRETE-ENCASED CONDUITS shall be:

1. PVC-40 for power and control wiring
 - a) Sweeps and risers for transition of PVC from below grade to above grade shall be PVC-GRS.
2. PVC-40 for instrumentation and telecommunications wiring.
 - a) Sweeps and risers for transition of PVC from concrete-encasement to above grade shall be PVC-GRS.
3. PVC-GRS for motor leads from VFDs.

ALL CONNECTIONS TO VIBRATING EQUIPMENT OR MOTORS shall be:

1. Liquidtight flexible metallic conduit for indoor, non-corrosive areas and all motor leads from VFDs.
2. Connection to equipment outdoors or in corrosive areas shall be with non-metallic liquidtight flexible conduit (except for motor leads from VFDs shall be flexible metallic.)

Installation

All conduits shall be concealed in the floor, walls, ceiling slab, or beneath the floor slab. Surface mounted conduit will not be accepted unless noted otherwise on the construction Plans.

Size of Raceways:

1. Raceway sizes as shown on the Plans, if not shown on the Plans, then size in accordance with NFPA 70.

2. Unless specifically indicated otherwise, the minimum raceway size shall be:

- a) Conduit: $\frac{3}{4}$ -inch
- b) Wireway: 4-inch by 4-inch

All raceways shall contain a separate grounding conductor.

Spare conduits shall contain one $\frac{3}{16}$ -inch diameter nylon pull rope.

Conduit routing is shown diagrammatic on the Plans. Contractor is responsible for routing the conduits in a neat manner, parallel and perpendicular to walls and ceilings.

Location of conduit ends are shown approximately. Contractor is responsible for ending conduits in location that will not conflict with electrical equipment. Route conduit ends to facilitate ease of equipment maintenance. Conduits extending from the floor to a device shall be located as close as possible to avoid creating a hazard.

Conduit shall not be routed on exterior of structures except as specifically indicated on the Plans.

Where water cannot drain to openings, provide drain fittings in the low spots of the conduit run.

Securely fasten raceways at intervals and locations required by NEC, or the type of raceway employed.

Provide all required openings in walls, floors and ceilings for conduit penetration.

1. Do not install one (1) inch and larger raceways in or through structural members (beams, slabs, etc.) unless approved by Engineer.
2. New Construction: Avoid cutting openings, where possible, by setting sleeves or frames in masonry and concrete, and by requesting openings in advance.
3. Existing Construction: Core drill openings in masonry and concrete. Avoid structural members and rebar.

Conduit encasement or embedment in the earth shall be separated from the earth by at least 3-inches of concrete unless otherwise shown on the Plans. Plastic conduit spacers shall be located five feet on centers. The spacers shall be secured to the conduits by wire ties. The conduits shall be watertight.

Analog signal conduits shall be separated from power or control conduits. The separation shall be a minimum of 12-inches for metallic conduits and 24-inches for nonmetallic conduits.

Install explosion-proof seal-offs in hazardous areas shown on the Plans and as required by the NEC.

Plastic raceway joints shall be solvent cemented in accordance with recommendations of raceway manufacturer.

All conduit openings not encased in a panel shall be sealed with duct seal.

16.72 Boxes and Enclosures

16.72.2 Outlet and Junction Boxes

[CSI 26 05 33.16]

Part 1 – General

Design Requirements

In corrosive areas, all junction boxes shall be NEMA 4X.

Outlet boxes and switch boxes shall be designed for mounting flush wiring devices.

Outlet boxes shall not be less than 4-inch square and 1½-inch deep. Ceiling boxes shall withstand a vertical force of 200 pounds for five minutes. Wall boxes shall withstand a vertical downward force of 50 pounds for five minutes.

Part 2 – Products

Materials

Use cast boxes with threaded hubs for all rigid and intermediate conduits. Steel boxes may be used with rigid and intermediate conduits where cast boxes are not allowed by the NEC. All boxes shall be of proper size to accommodate devices, connectors, and number of wires present in the box. Boxes shall be readily accessible.

Cast box bodies and cover shall be cast or malleable iron with a minimum wall thickness of ⅛-inch at every point, and not less than ¼-inch at tapped holes for rigid conduit. Bosses are not acceptable. Mounting lugs shall be provided at the back or bottom corners of the body. Covers shall be secured to the box body with No. 6 or larger brass or bronze flathead screws. Boxes shall be provided with neoprene cover gaskets. Outlet boxes shall be of the FS types. Boxes shall conform to FS W-C-586C and UL 514.

Sheet metal boxes shall conform to UL 50, with a hot-dipped galvanized finish conforming to ASTM A123. Boxes and box extension rings shall be provided with knockouts. Boxes shall be formed in one piece from carbon-steel sheets.

Non-metallic boxes shall be hot-compressed fiberglass, one-piece, molded with reinforcing of polyester material, with a minimum wall thickness of ⅛-inch.

Finishes

Where only cast aluminum is available for certain types of fixture boxes, an epoxy finish shall be provided.

16.72.3 Watertight Enclosures

[CSI 26 05 33.17]

Part 2 – Products

Manufacturers

The watertight enclosure shall be equal to Hoffman.

Materials

Watertight enclosures for vault electrical outlets shall be molded from fiberglass reinforced polyester material. A hinged cover shall be gasketed and opened with quick release latches. The conduit penetrations shall be sealed watertight.

Part 3 – Execution

Installation

An epoxy plug shall be installed in the conduit to prevent the migration of water into the conduit. The enclosure shall be NEMA rated and installed per all applicable codes.

16.75 Wiring Devices

[CSI 26 27 26]

16.75.1 Common Work for Wiring Devices

[CSI 26 27 26]

Part 3 - Execution

Installation

Wiring Devices

1. Position of Outlets: All outlets shall be centered with regard to building lines, furring and trim, symmetrically arranged in the room or outside the structure. Device outlets shall be set plumb and shall extend flush to the finished surface of the wall, ceiling or floor without projecting beyond the same.
2. Unless otherwise noted, wall mounted outlet devices shall generally be 24-inches above the floor, 18 inches in architecturally treated areas, above process piping near process valve boards. Switches shall be 48 inches above the finished floor unless otherwise noted.

Installation of Wall Plates

1. Interior Dry Locations: Install plates so that all four edges are in continuous contact with the finished wall surfaces. Plaster filled will not be permitted. Do not use oversize plates or sectional plates.
2. Exterior and/or Wet Locations: Install plates with gaskets on wiring devices in such a manner as to provide a rain tight weatherproof installation. For receptacle devices, these plates shall maintain the weatherproof rating with an attachment plug inserted and be rated extra-duty. Cover type shall match box type.

Testing

After installation of receptacles, circuits shall be energized, and each receptacle tested for proper ground continuity, reversed polarity, and/or open neutral condition.

GFI receptacles shall be tested with the circuits energized. Devices shall be tested with a portable GFI receptacle tester capable of circulating 7.5 milliamperes of current, when plugged

in, between the “hot” line and “ground” to produce tripping of the receptacle. Resetting and tripping shall be checked at least twice at each GFI receptacle.

Submit results of all field testing to the Engineer for review.

16.75.2 Receptacles

[CSI 26 27 19]

Part 1 – General

Design Requirements

Receptacles shall be heavy duty, high abuse, grounding type conforming to NEMA configurations, NEMA WD1 and UL 514 Standards.

Part 2 – Products

Materials

Single and Duplex Receptacles

1. Indoor Clean Areas: Receptacles shall be duplex, 20 amp, NEMA 5-20R, and shall accept NEMA 5-15P and 5-15P plug caps. Receptacles shall be Hubbel 5362, General Electric 4108-2, or equal. Color shall be brown in industrial areas and ivory or white in office and laboratory areas.
2. Outdoor, Process, or Corrosive Areas: Receptacles shall be duplex, 20 amp, NEMA 5-20R, and shall accept NEMA 5-15P and 5-20P plug caps. Receptacle and plug caps shall be corrosion resistant, marine duty with yellow polycarbonate weatherproof lift covers. Receptacles shall be Hubbell 53CM62/53CM21 or equal.

GFI Receptacles

1. Device shall be rated 20 amp, 2-pole, 3-wire, 120-volt, conforming to NEMA WD1.10 configuration. Device shall have a test and reset push buttons. GFI device shall be Hubbell 5362 or equal.

Surface Multiple Outlet Assemblies

1. Units shall have outlets on center-to-center spacing as shown on the Plans. Assembly shall conform to Article 353 of the NEC.

16.75.3 Line Voltage Switches

[CSI 26 27 26.21]

Part 2 – Products

Manufacturers

- Sierra Electric
- Monumental Grade, Catalog No. 5721
- Daniel Woodhead 1900 series

- Or Equal

Materials

Line Voltage Types: Switches shall be rated 20 amps at 120 or 277 volts AC only. Units shall be flush mounted, self-grounding, quiet operating toggle devices. Handle color shall be brown in industrial areas and white or ivory in office or laboratory areas. Units shall conform to Federal Specifications W-S-896 D and E, UL 20, and NEMA WD1 standards.

16.75.5 Plates

[CSI 26 27 26.31]

Part 1 – General

Design Requirements

Plates shall be of the style and color to match the wiring devices, and of the required number of gangs. Plates shall conform to NEMA WD1, UL 514, and ANSI C73. In noncorrosive indoor areas, device plates shall be made of sheet steel, zinc electroplated with chrome finish.

Device plates in corrosive or outdoor areas shall be corrosion-resistant/marine-duty type with weather protective double doors. Device plates for explosion-proof equipment shall be factory provided with the equipment.

Part 2 – Products

Manufacturers

As manufactured by

- Crouse-Hinds
- Appleton
- Or Equal

Components

Device plates shall be provided with engraved laminated phenolic nameplates with 1/8-inch white characters on black background. Nameplates for switches shall identify panel and circuit number and area served. Nameplates for receptacles shall identify circuit and voltage if other than 120 volts, single-phase.

16.85 Lighting

[CSI 26 50 00]

16.85.1 Common Work for Lighting Fixtures

[CSI 26 50 05]

Part 1 - General

Design Requirements

Fixtures shall be a standard, cataloged item general description as called for on the Plans. All fixtures shall be UL approved and so labeled. Provide suitable supports and mountings.

Part 2 – Products

Manufacturers

As shown on Plans. Equals will be accepted.

16.85.2 Lamps

[CSI 26 06 50 or 26 50 06.13]

Part 1 - General

Design Requirements

Provide all lamps as specified. Refer to the Lighting Fixture Schedule on the Plans for the ordering information on lamps. Fluorescent lamps shall be standard type, not energy efficient type due to low temperature conditions. Lamps shall be new at the time of acceptance.

Lamps shall be provided for all lighting fixtures.

Warranty

Lamps that fail within 90 days after acceptance by the Owner shall be replaced at no cost to the Owner.

Part 2 – Products

Manufacturers

Approved manufacturers:

- Westinghouse
- Sylvania
- G.E.

16.85.3 Fixtures

[CSI 26 06 50.16 or 26 50 06.16]

Part 1 - General

Design Requirements

Fixtures shall be of the types, wattages, and voltages shown on the Plans, comply with UL 57, and shall be UL classified and labeled for intended use. Fixtures for use in hazardous locations shall be UL listed per UL Standard 844.

16.85.4 Ballast

[CSI 26 50 06.18]

Part 1 - General

Design Requirements

Fluorescent lamp ballast shall be UL "P" rated. Ballast shall be CBM certified and bear the UL label. Ballast shall be General Electric Maxi-Miser II, Advance Mark II, or equal.

Ballasts in luminaries for exterior use shall provide reliable starting of lamps at 0 degrees Fahrenheit at 90 percent of the nominal line voltage. All locations, other than totally enclosed rooms, shall be considered exterior.

Warranty

Ballasts producing excessive noise (above 36 dB) or vibration will be rejected and shall be replaced at no expense to the Owner.

16.95 Testing

[CSI 26 08 00]

16.95.1 Common Work for Testing

[CSI 26 08 05]

Part 1 - General

Submittals

Test reports shall be submitted to the Engineer prior to final acceptance in accordance with Division 1.33 of these specifications.

Scheduling and Coordination

The Contractor shall inform the Engineer in advance of testing in accordance with the requirements listed in Division 1 of these specifications.

Prior to scheduling the testing, the Contractor shall have satisfied themselves that the project area is properly cleaned up; all patching and painting deemed necessary properly completed; and all systems, equipment and controls are functioning as intended.

Part 2 - Products

Source Quality Control

Submit reports of factory tests and adjustments performed by equipment manufacturers to the Engineer prior to field testing and adjustment of equipment. These reports shall identify the equipment and show dates, results of test, measured values and final adjustment settings. Provide factory tests and adjustments for equipment where factory tests are specified in the equipment specifications. The Engineer may inspect the fabricated equipment at the factory before shipment to job site. Provide the Engineer with sufficient prior notice so that an inspection can be arranged at the factory.

Part 3 – Execution

Site Testing

Test all circuits for continuity, freedom from ground, and proper operation during progress of the work.

Insulation Resistance, Continuity, and Rotation: Perform routine insulation resistance, continuity and rotation tests for all distribution and utilization equipment prior and in addition to tests performed by the testing laboratory specified herein.

Electric Motors: Perform voltage, current and resistance tests on all motors ½ horsepower and larger installed this project. Insulation resistance readings shall be taken with a 500-volt megger for 30 seconds with the circuit conductors connected to the motor. Verify that an overload condition does not exist.

Conduct special test as required for service and/or system ground.

Field Quality Control

General

1. Conduct final test in the presence of Owner and/or their authorized representative. Contractor shall provide all testing instrumentation and labor required to demonstrate satisfactory operation of systems, equipment and controls.

Operational Tests

1. Operational test all circuits to demonstrate that the circuits and equipment have been properly installed, adjusted and are ready for full-time service. Demonstrate the proper functioning of circuits in all modes of operation, and including alarm conditions, and demonstrate satisfactory interfacing with the data acquisition and alarm systems.

16.95.3 Conductor Test Report

[CSI 26 08 13]

Conductor Test Report Page 1 of 1														
PROJECT:										OWNER:				
Contractor Co. Name:										Phone Number:				
Tested by:										Test Date:				
Race- way	V	C	Operating Load Voltage					Insulation Resistance - OHMS						
Label	(1)	(2)	(3)	VAB	VCB	VCA	VAN	VCN	A-B	B-C	C-A	A-G	B-G	C-G
A														
B														
C														
D														
E														
F														
G														

1. Refer to raceway and wire schedule and one-line diagram for description of feeder identified by label shown on this report
2. Visual Inspection – Check when completed
3. Continuity Test – Check when completed

16.95.4 Ground Electrode Resistance Test Report

[CSI 26 08 15]

Ground Electrode Resistance Test Report	
PROJECT:	OWNER:
Contractor Co. Name:	Phone Number:
Tested by:	Test Date:
Test Meter Type:	
Test Distance-D:	
Soil Conditions:	
Measured Resistance:	
DESCRIPTION OF TEST PROCEDURE, CONDITIONS, RESULTS:	

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Division 17

Automatic Control

17.00 GENERAL

This division covers all work necessary for furnishing, installing, adjusting, testing, documenting, and starting-up the Instrumentation and Control (I&C) and Telemetry System. Programmable logic controller (PLC) shall provide local, automatic control of on-site pumps and control valves. Computer-based telemetry system will provide remote control, alarm presentation, and data logging activities at the Owner's headquarters location.

Sections in these specifications titled “*Common Work for . . .*” shall apply to all following related subsections whether directly referenced or not.

These specifications are an integral part of the contract documents for the I&C and Telemetry portion of this contract. The written descriptions of system performance contained herein are given to assist the Contractor in interpreting the contract plans but are not intended to be all-inclusive. The Contractor shall be aware that all automatic control systems do not require the same components and accessories for complete system operation. Therefore, these specifications do not include all accessories and appurtenances required for a complete system. The Contractor shall, however, provide all accessories and appurtenances to result in a completely operational system as required to meet the functional requirements of these documents. Where specific equipment specifications are given, they are used to represent the level of quality required by these documents.

17.05 Common Work for Automatic Control

[CSI 40 60 05]

Part 1 - General

Summary

The work under this division covers construction specifically described in these specifications. Project Plans will be provided for this project. All work incidental and necessary to the completion of the project described herein shall be completed under the bid item listed in the bid proposal, and no other compensation will be allowed. The work generally consists of the following:

- Detailed system layout and design for the particular equipment bid in accordance with these functional specifications.
- Furnishing of I&C equipment including delivery, storage, software, programming, installation, testing, startup, and documentation.
- Providing operator maintenance manuals for all equipment and devices provided by this Contract.
- Providing system training to the operators of the proposed equipment.

Related Sections

- Division 16 Electrical

References

The project Plans are based on Instrument Society of America (ISA) standards numbers S5.1, S5.2, S5.3, and S5.4. The Contractor is encouraged to be familiar with these standards since the project plans do not contain wiring or ladder diagrams, but are based on the functional requirements of the ISA format.

All equipment and materials shall conform to the latest revised editions of applicable standards published by the following organizations:

- American National Standards Institute (ANSI).
- Institute of Electrical and Electronic Engineers (IEEE).
- National Electrical Manufacturers Association (NEMA).
- Underwriters' Laboratories (U/L).
- Instrument Society of America (ISA)

All equipment and materials, and the design, construction, installation, and application thereof shall comply with all applicable provisions of the National Electrical Code (NEC), the Occupational Safety and Health Act (OSHA), and any applicable Federal, State, and local ordinances, rules and regulations. All materials and equipment specified herein shall be within the scope of Underwriter's Laboratory (UL) examination services, be approved by the UL for the purpose for which they are used and shall bear the UL label.

All control panels shall bear a label by UL or by an approved testing authority for the completed assembled panel.

Definitions

Contractor: The Contractor, as distinct from the Control System Integrator, shall install panels and other materials furnished by the Control System Integrator and provide all materials and work necessary and thereby, satisfy all requirements that are within the scope of this section.

Control System Integrator: A single firm preselected by the Owner and subcontracted by the Contractor, who shall design and furnish the system, provide the instrument panels; provide the PLCs, RTU's, Motor Control Center, VFD's, ventilation control panel, assemble and test the control panel equipment, and program PLCs, computers, and other instrument components and provide start-up and training services. The Control System Integrator for this contract shall be: S&B Inc.

Submittals

All submittals shall be complete, neat, orderly and indexed. Partial submittals will not be accepted. Submittal information shall be provided to the Owner for the following items:

- Telemetry Panels
- Motor Control Centers
- Variable Frequency Drives
- Pump 1 Motor Starter Panel

- Ventilation Control Panel
- Blower Control Panel
- Liquid Level Switches
- Level Transmitters
- Pressure Transmitters
- Level Floats
- Wall Mounted Heating Thermostat
- Wall Mounted Cooling Thermostat
- Photoelectric Smoke Detector
- Intrusion Proximity Alarm Switch
- Operator in Trouble (Panic) Alarm Button
- Operation and Maintenance Manuals per Division 1.79.2 and Division 17.94
- Full size nameplate wording schedules, in lettering style proposed for use.

In addition to the requirements of Division 1.33, the Contractor shall develop and submit the following information provided by the Control System Integrator.

Hardware Submittals

Before any components are fabricated, and/or integrated into assemblies, or shipped to the site, the Contractor shall prepare a complete hardware submittal. The Engineer shall require five (5) sets, including fully detailed shop drawing, catalog cuts, wiring connections, and such other descriptive matter and documentation as may be required to fully describe the equipment and to demonstrate its conformity to these Specifications. The decision of the Engineer, upon the acceptability of any submittal, shall be final. Catalog information shall be submitted for all components and equipment, regardless of whether or not it is of the same manufacture as that listed in the Specifications.

System Plan Submittals

Following approval of the hardware submittal, the Control System Integrator shall prepare complete system interconnect wiring diagrams and panel layout plans for approval.

Plans

The Control System Integrator shall develop all shop drawings required for design, fabrication, assembly and installation of the control system. Shop drawings shall include all plans required in manufacture of specialized components and for assembly and installation of them.

Plans shall be prepared with a CAD program capable of exporting to AutoCAD format, and printed on 11-inch by 17-inch media. Plans shall have borders and title blocks identifying the project system, revisions to the plans, and type of plan. Each revision of a plan shall carry a date and brief description of the revisions. Diagrams shall carry a date and brief description of the revisions. Diagrams shall carry a uniform and coordinated set of wire numbers and

terminal block numbers in compliance with panel work wiring. Additionally, one set of electronic .DWG files shall be provided to the Owner.

Elementary Diagrams

The Contractor shall provide elementary diagrams for all discrete loops. Loop diagrams shall be prepared in compliance with ISA S5.4 and shall be provided for all analog loops. Elementary diagrams and loop diagrams shall show circuits and devices of a system. These diagrams shall be arranged to emphasize device elements and their functions as an aid to understanding the operation of a system and maintaining or troubleshooting that system. Elementary and loop diagrams shall also show wire numbers, wire color codes, signal polarities, and terminal block numbers.

Panel Fabrication and Arrangements Plans

The Contractor shall provide arrangement plans of all panel front- and internal-mounted instruments, switches, devices, and equipment indicated. All panel mounting details shall be shown. Outer dimensions of all panels shall be included on the plan. Deviations from approved arrangements require approval prior to installation.

Arrangement plans shall be drawn to scale using standard Architectural or Engineering scales.

Site Conditions

Specified instrumentation and control equipment shall be modified, if necessary, to make it suitable for operation in the ambient conditions specified in Division 16.

Warranty

In addition to any other warranties required by the specifications, the entire PLC system will be warranted against defects in materials, workmanship, and software functions for a period of one (1) calendar year following the successful completion of the Functional Acceptance Test (FAT). The Contractor or designated service organization will be available on 24-hour notice to correct any system problems without charge to the Owner during the warranty period. In addition, the Contractor will provide four 2-day site visits during the warranty period to perform inspection and calibration of the equipment or other work at the request of the Owner.

Extra Materials

The Contractor shall supply sufficient spare parts, components, and assemblies to replace *any* defective or malfunctioning control component provided in this system. Control components are considered any device or combination of devices without which normal automatic control as outlined in this specification cannot be accomplished, and includes:

1. Two (2) spares of each part, component, or assembly, if more than ten (10) of those components are normally in use in the system.
2. One (1) box of each fuse type provided on this project. If ten (10) or more of a fuse type is provided for the project, then two (2) spare boxes shall be provided.

Spare part components shall be packaged for at ease of field installation by non-trained personnel, so that no soldering or special skills are required for installation. All spare parts shall be delivered in a hinged plastic box that is purposefully made for this contract. The box

shall have a parts list permanently attached to the inside lid which lists all parts and refers to them by numbered code visible on the outside of the package. Fragile components shall be adequately protected with cut foam. Electronic components shall be wrapped in ultra-violet inhibiting file. The exterior of the box shall be labeled "Telemetry Spare Parts – Water Department." Provide the box with lifting handles.

Part 2 – Products

Components

These Specifications list major instruments required to provide the process instrumentation system. All instrument functions specified on this list shall be provided by the Control System Integrator. Any additional instruments required to complete the instrument loops because of certain characteristics of the particular equipment selected by the Control System Integrator shall be provided. Such additional instruments shall be provided and included in the original contract price even though not specified in the instrument index or on the Plans.

The following systems utilize automatic control:

- Pump controls
- Valve controls

Accessories

Provide all accessories required to furnish a complete control system that meets the requirements of the Plans and Specifications.

Source Quality Control

Material shall be new, free from defects, and of the quality specified. All equipment and materials utilized in the system shall be the products of Manufacturers with at least five (5) years of experience in the manufacture of similar equipment. Similar items in the system shall be the products of the same Manufacturer. All equipment shall be of industrial grade and of standard construction, shall be capable of long, reliable, trouble-free service, and shall be specifically intended for control and monitoring of operation of motor-driven pumps and equipment. All equipment shall be of modular design to facilitate interchangeability of parts and to assure ease of servicing.

Part 3 - Execution

Installers

Installation shall be performed by the workers who are skilled and experienced in the installation of I&C and Telemetry systems.

Installation

Installation and testing procedures shall be as specified in these and subsequent sections of this division.

The control system shall be installed in accordance with the installation plans and instructions prepared by the Control System Integrator.

Installation shall include all elements and components of control system and all conduit and interconnecting wiring between all elements, components, sensors, and valve operators.

Equipment shall be located so that it is readily accessible for operation and maintenance.

Field Equipment

Equipment shall be provided as specified on the Plans such that ports and adjustments are accessible for in-place testing and calibration. Where possible, equipment shall be located between 48 inches and 60 inches, unless specified otherwise on the Plans, above the floor or a permanent work platform. Instrumentation equipment shall be mounted for unobstructed access, but mounting shall not obstruct walkways. Equipment shall be mounted where shock or vibration will not impair its operation. Support systems shall not be attached to handrails, process piping or mechanical equipment except for measuring elements and valve positioners. Instruments and cabinets supported directly by concrete or concrete block walls shall be spaced out not less than $\frac{5}{8}$ -inch by framing channel between instrument and wall.

Steel used for support of equipment shall be hot-dip galvanized after fabrication. Support systems including panels shall be designed in accordance with the Seismic Restraint and Anchorage section of Division 1.81 of these specifications and to prevent deformation greater than $\frac{1}{8}$ -inch under the attached equipment load and an external load of 200 pounds in any direction.

Electrical Power Connection

Electric power wiring and equipment shall be in compliance with Division 16. Power disconnect switches shall be provided within sight of equipment and shall be labeled to indicate opened and closed positions and specific equipment served. "Within sight of" is defined as having a clear unobstructed view from the equipment served and within 50 feet of the equipment served. Disconnect switches shall be mounted between 36 inches and 72 inches above the floor or permanent work platform. Where equipment location is such that the above requirements cannot be met by a single disconnect switch, two switches, one at the equipment and one at the work platform, shall be provided.

Signal Connection

Electrical signal connections to equipment shall be made on terminal blocks or by locking plug and receptacle assemblies. Jacketed flexible conduit shall be used between equipment and rigid raceway systems except that flexible cable assemblies may be used where plug and receptacle assemblies are provided and the installation is not subject to mechanical damage in normal use. The length of flexible conduit or cord assemblies shall not exceed 2 feet. Flexible cable, receptacle and plug assemblies shall be used only where specified.

17.06 Control System Integrator

[CSI 40 61 13]

Part 1 - General

Division of Responsibility

All instrumentation and industrial electronic systems shall be provided under the supervision of a single Control System Integrator, chosen by the Owner, which is regularly engaged in the

design and installation of such systems of similar scope and complexity. The Control Systems Integrator shall be enjoined by the Contractor as a Subcontractor. The assignment of specific responsibilities herein to the Control System Integrator shall not, in any way and under any conditions, diminish 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 Control System Integrator shall specifically require that the Control System Integrator conform to and meet all requirements specified in the contract documents.

The assignment of a Control System Integrator that is an equipment supplier shall not be acceptable.

Control System Integrator's Responsibility

The Control System Integrator shall be solely and completely responsible for the final design and assembly of the entire control system. Responsibilities include:

- Provision of, and the detailed design of, custom control panels and the motor control center. The plans show general layout of the control panels. The Integrator shall provide detailed scaled design of all components on and in the control panels and determine specific requirements.
- The design of all interconnecting wiring of control equipment including remote control panels, packaged equipment panels, mechanical equipment with control components, etc.
- Testing of the control panels in the Control System Integrator's shop.
- Coordinate with the Contractor for specific requirements and locations of raceway penetrations and field wiring in control panels.
- The Control System Integrator shall supply the Contractor with all necessary detailed installation plans and/or written instruction for installation of all control components and sensing devices for proper system operation.
- Provide installation assistance.
- Programming of the PLC's.
- Programming of the graphical touch screen operator interfaces (OI) on the control panels.
- MTU and Human Machine Interface (HMI) programming at the Owners Headquarters.
- Provide Startup and Training Services.

General and Electrical Contractor's Responsibilities

The General and Electrical Contractor shall be responsible for the following equipment and services:

- Review of the Control System Integrator's submittals and wiring diagrams for coordination with space requirements, raceway requirements of field wiring, etc.

- Supply the Integrator with submittals of equipment related to the control system that the Integrator must include in their submittals and integrate. Such as motors, packaged control panels that the Integrator does not build, etc.
- Installation of the control panels provided by the Control System Integrator.
- Installation of the interconnecting wiring in accordance with these documents and the Control System Integrators wiring diagrams.
- Installation of I&C and Telemetry System components in accordance with these documents and plans or instructions of the Control System Integrator.

Part 3 – Execution

Installers

The Control System shall be designed, constructed, programmed and commissioned by full time employees with a minimum of 5 years of experience (minimum of 1 year with Integrator).

Integrators List

The Control System Integrator shall be:

- Stead and Associates (S&B Inc.), Bellevue, Washington

17.08 System Description

[CSI 40 61 96]

Part 1 – General

Summary

The I&C and Telemetry system functions required are specified on the Plans and in subsequent sections of this Division.

Design and Performance Requirements

The system shall be designed to provide the control capabilities and functions indicated and implied by the Plans and these Specifications and to provide trouble-free operation with minimum maintenance. The system shall readily enable manual operation of any and all functions in the event of failure of any one component.

The control system shall be designed and assembled by the Control System Integrator to provide:

- Control of motor driven pumps, equipment, and processes.
- Monitoring of operation of motor driven pumps, equipment, and processes.
- Indication of operating status of motor driven pumps, equipment, and processes.
- Monitoring and indication of pressures, temperatures, levels, and flows, as indicated and implied by the Plans and Specifications.
- The capabilities indicated and implied by the Plans and Specifications.

The I&C and Telemetry System shall be designed and assembled by the Control System Integrator to be an integrated system composed completely of components which are specifically designed and used for and in conjunction with control and operation of motor-driven pumps and process control equipment. The Control System Integrator shall supply all interfacing equipment, appurtenances and accessories and all such devices that may be required for proper interfacing as part of the control system.

Part 2 – Products

Manufacturers

The telemetry components of the RTU shall be manufactured by Siemens to be consistent with the Owner's existing system.

Components

The I&C and Telemetry System shall include the instruments, control devices, Remote Telemetry Unit, Human Machine Interface, input and output devices, sensors, interfacing devices, cabinets, enclosures and other components indicated and implied by the Plans and Specifications.

The following is a list of the RTUs, Control Panels, Pressure and Level Assemblies, and Motor Control Centers to be provided by the Control System Integrator:

- Telemetry Panels
- Pump 1 Motor Starter Panel
- Two (2) Pump Station Discharge Pressure Assembly
- Pump Station Suction Pressure Assembly
- Reservoir Inlet/Outlet Pressure Transmitter Assembly
- Ventilation Control Panel
- Blower Control Panel
- Motor Control Center

Part 3 – Execution

Preparation

The Control System Integrator shall be responsible for the coordination and integration of control system with the motor control and other related equipment. The Control System Integrator shall communicate directly with the Manufacturer(s) and Supplier(s) of all related equipment to determine all details of the equipment, which may influence or affect the control system. The Control System Integrator shall determine all requirements for and shall cause integration of the control system into a unified operating system. The Control System Integrator shall define all requirements for all interfacing equipment and shall supply all appurtenances, accessories and all such devices, which may be required for proper interfacing as part of the control system.

The Control System Integrator shall be responsible to obtain submittal information on equipment supplied by other disciplines and to integrate them into the control system to form a complete working package as outlined by the contract documents.

Installation

The system shall be completely assembled in the shop by the Control System Integrator. All components and equipment shall be prewired to the maximum extent possible.

All Process Control shall be done within the control panels unless specifically listed on the Plans as other.

Functional Description

These functional descriptions describe the control strategy for each loop in the facility. These descriptions are intended to be an extension of the Plans that are provided as part of the design contract documents.

Background and Pump Schedule

The 950/1010 Booster Pump Station (BPS) shall operate continuously to maintain a discharge hydraulic grade line (HGL) of 1,010 feet at flow rates of 765 gallons per minute (gpm) peak hour demand (PHD) or less. For flow rates between PHD and PHD + fire flow (FF) (2,300 gpm), the 950/1010 BPS will operate with a discharge HGL of 1,038 feet.

BPS DISCHARGE HGL

Flow Rate Range (gpm)	Discharge HGL (feet)
0 to 765	1,010
765 to 2,300	1,038

The BPS shall be equipped with 6 pumps that will be called to run based on system demands.

PUMP SCHEDULE

Pump No.	Pump Model (Assumed)	Horsepower (HP)	Starting Method
1	Grundfos CR 10-3-3ph	3	Across-the-line starter
2	Cornell 1.5WH	7.5	Variable frequency drive
3	Cornell 2.5WH	15	Variable frequency drive
4	Cornell 2.5WH	20	Variable frequency drive
5	Cornell 6H	125	Soft starter
6	Cornell 6H	125	Soft starter

Pumps shall be staged up and down based on pressure and flow, respectively. Each stage shall have operator-adjustable stage up and down timers for both pressure and flow. The pressure relief valves shall re-circulate water to maintain discharge pressure when fixed-speed pumps are running. Pumps equipped with variable frequency drives (VFDs) shall have their percentage of full speed varied to maintain the discharge pressure. When multiple pumps are operating simultaneously, they shall operate at the same speed.

Pressure Relief Valve Setpoints

The 1 1/2-inch pressure relief valve shall have a setting of 1,015 feet HGL and shall establish the BPS discharge HGL when Pump 1 is running. The 1 1/2-inch shall be called to close when Pump Nos. 2, 3, 4, 5, or 6 are running to prevent unnecessary recirculation of water. The VFDs shall establish the 950/1010 BPS discharge HGL when any of Pump Nos. 2, 3, and 4 are running. The 6-inch pressure relief valve shall have a setting of 1,043 feet HGL which will establish the BPS discharge HGL when Pump Nos. 5 or 6 are running and provide emergency pressure relief when the other pumps are running.

Pump Staging

The flow rates listed in the pump staging table should be interpreted as a general guide for what flow rates the pumps will be operating at to achieve the full range of flow within each stage. Pumps shall be staged up based on pressure and staged down based on flow rate as described below. Flow rate shall not be used as the control variable for controlling the speed of the VFD-equipped pumps. The pump speeds shall be modulated to maintain the discharge pressure described above.

PUMP STAGING

Pump Sequence	Pump Nos.	HP	Approximate Flow Range (gpm)	Active Relief Valve
1	1	3	0 to 40	1 1/2 and 6-inch
2	2	7.5	40 to 150	6-inch
3	2 and 3	1 (7.5) 1 (15)	150 to 400	6-inch
4	2, 3, and 4	1 (7.5) 1 (15) 1 (20)	400 to 765	6-inch
5	5 or 6	125	765 to 2,300	6-inch

Pump Stage-Up

Below a flow rate of 765 gpm, pumps shall be staged up as necessary to maintain a discharge HGL of 1,010 feet.

Pump No. 1 shall only operate by itself and shall operate at full speed with the pumped flow in excess of demand recirculated through the 1 1/2-inch pressure relief valve.

When system demands exceed the capacity of Pump No. 1 to maintain a discharge HGL of 1,015 feet, Pump No. 2 shall be called to operate with VFD speed adjusted to maintain a discharge HGL of 1,010 feet. Pump No. 1 shall then be shut down and the 1 1/2-inch pressure relief valve shall be closed.

When system demands exceed the capacity of Pump No. 2 to maintain a discharge HGL of 1,010 feet, Pump No. 3 shall be called to operate simultaneously with Pump No. 2, and their VFD speeds shall be matched.

When system demands exceed the combined capacity of Pump Nos. 2 and 3 to maintain a discharge HGL of 1,010 feet, Pump No. 4 shall be called to operate simultaneously with Pump Nos. 2 and 3, and all three VFD speeds shall be matched.

Above a flow rate of 765 gpm, pumps shall be staged up as necessary to maintain a discharge HGL of 1,038 feet. When system demands exceed the combined capacity of Pump Nos. 2, 3, and 4 to maintain a discharge HGL of 1,038 feet, Pump No. 5 or 6 shall be called to operate at full speed with the pumped flow in excess of demand being recirculated through the 6-inch. Pump Nos. 2, 3, and 4 shall then be shut down.

Pump Stage-Down

If Pump No. 5 or 6 is operating and the system demand (as measured by the flow meter on the discharge of the BPS) drops to 765 gpm, Pump Nos. 2, 3, and 4 shall be called to operate, maintaining a discharge HGL of 1,010 feet with matched VFD speeds. Pump No. 5 or 6 shall then be shut down.

If Pump Nos. 2, 3, and 4 are operating and the system demand drops to 400 gpm, Pump Nos. 2 and 3 shall operate together to maintain a discharge HGL of 1,010 feet with matched VFD speeds, and Pump No. 4 shall be shut down.

If Pump Nos. 2 and 3 are operating and the system demand drops to 150 gpm, Pump No. 2 shall operate to maintain a discharge HGL of 1,010 feet, and Pump No. 3 shall be shut down.

If Pump No. 2 is operating and the system demand drops to 40 gpm, the 1 1/2-inch pressure relief valve shall be activated, and Pump No. 1 shall operate at full speed with the pumped flow in excess of demand recirculated through the 1 1/2-inch pressure relief valve. Pump No. 2 shall then be shut down.

Pump Minimum Runtime and Alternation

An operator adjustable minimum pump runtime shall be incorporated when a pump is called to start to prevent pumps from turning on and off quickly. If a pump has been called to turn on and off quickly, the pump shall operate for the minimum pump runtime, recirculating excess flow through the 6-inch pressure relief valve if needed.

Pump Nos. 5 and 6 shall alternate individual operation each time a fire flow pump is called to operate.

17.10 PANELS

[CSI 40 67 00]

17.12 Equipment Panels

[CSI 40 67 16, 40 67 19]

Part 1 – General

Related Sections

All panels shall be labeled.

References

Panels shall meet the requirements of UL-508 for water systems and UL-913 for sewer systems. All panels shall bear the appropriate label. The provider of the panels shall be a UL_508A certified facility. All field modifications shall be in conformance with UL-508 or UL-913.

Design Requirements

Control equipment panels shall be enclosures conforming to the requirements of the National Electrical Manufacturers Association (NEMA) and shall be NEMA 12 for indoor use.

Part 2 – Products

Components

- Enclosure shall be constructed of steel.
- Minimal metal thickness shall be 14-gauge.
- All doors shall be rubber-gasketed with continuous hinge and key locking latch mechanism.
- Wherever practical, enclosures shall be a manufactured item.
- All doors shall be provided with quick-release latches to secure cover.
- Panels shall be sized to adequately dissipate heat generated by equipment mounted in or on the panel.
- Enclosure shall include a backpan.
- Enclosure shall be finished in ANSI 61 gray polyester powder coating inside and out over phosphatized surfaces.
- The enclosure shall be oversized to accommodate future racks and auxiliary devices as required.
- All outdoor enclosures shall be provided with a control panel heater and ventilation fan and filter with built-in thermostat to provide adequate climate control.

Fabrication

Panels should be completely fabricated, and instruments installed and wired in the manufacturer's factory (where possible). All wiring shall be completed and tested prior to shipment. All external connections shall be by way of numbered terminal blocks. Panel cutouts for instruments and devices shall be cut, punched or drilled and smoothly finished with rounded edges.

17.20 PANEL COMPONENTS

[CSI 40 78 00]

Part 1 - General

Design Requirements

All components shall be suitable for installation inside the I&C and Telemetry system panel enclosure.

17.20.3 Terminal Blocks

[CSI 40 78 71]

Part 1 - General

Design Requirements

Terminal blocks shall be one-piece molded plastic blocks with screw-type terminals and barriers rated for 600 volts. Terminals shall be double-sided and supplied with removable covers to prevent accidental contact with live circuits. Terminals shall have permanent, legible identification, and be clearly visible with the protective cover removed.

Fusible terminal blocks shall be provided with a LED blown fuse indicator for each terminal.

Part 3 - Execution

Installation

All wires between panel-mounted equipment and other equipment shall be terminated at terminal blocks. Switches shall be terminated at the terminal blocks with crimp-type, pre-insulated, ring-tongue lugs. Lugs shall be of the appropriate size for their terminal block screws and for the number and size of the wires terminated.

17.21 Power Supply and Protection

17.21.2 Normal Power Supply

[CSI 40 78 59]

Part 1 - General

Design Requirements

All equipment panels shall be provided with 120-volt, 60-Hz power. Make provisions for conduit entry and provide a terminal block for termination of the circuit wires. All electronic

control panel components shall require a 120 VAC-24 VDC power supply. DC power supply shall be sized to provide at least 50 percent more current than the peak current demands of the control panel. DC power supply shall have UPS backup power capabilities as identified in Section 17.21.3. Protection equipment shall consist of circuit breakers and fuses to protect electrical circuits from short circuits and overloads.

Part 2 – Products

Manufacturers

DC power supplies shall be Siemens, or approved equal.

Fuses shall be Bussmann Manufacturing Model ABC or MDA rated for Branch circuit, or approved equal.

Circuit Breakers shall be Siemens rated for Branch circuit, or approved equal.

Part 3 – Execution

Construction

Branch circuits shall be individually fused with an indication of fuse opening. All fuse holders for the panel shall be grouped on a single sub-panel. They shall be so situated that when the panel door is opened there is a clear view of the indicators and clear access for replacement of the fuses.

Provide DC power supplies as required to power instruments requiring external DC power of the appropriate voltages, with sufficient voltage regulation and ripple control to assure that the instruments being supplied can operate within their required tolerances. The power supplies at all RTUs shall include batteries for a backup power supply and charging equipment.

17.21.3 Backup Power Supply

[CSI 40 67 63]

Part 1 - General

Design Requirements

All equipment panels shall have an Uninterruptable DC Power Module that interfaces with the Normal DC Power Supply. The Uninterruptable DC Power Module shall be capable of powering the control panel equipment for a period of not less than 24 hours after normal power failure. Transfer shall be a non-mechanical, non-interruptible, smooth transfer to battery backup.

Remote equipment batteries shall be sealed lead-acid batteries of sufficient ampere hour capacity to meet the above requirements.

Performance Requirements

The master console shall display power failure, and also a low battery condition alarm for the new equipment. A power failure alarm shall occur in the format currently used by the system. A low battery condition alarm shall cause the alarm indicator to flash but will not sound the audible alarm. The indicating light shall go off when the alarm condition is clear.

Part 3 – Execution

Installation

Batteries, battery chargers, and necessary wiring shall be installed to meet the above specifications.

17.21.5 Line Protection Units – Low Current

[CSI 40 78 56.15]

Part 1 - General

Design Requirements

The line protection unit shall isolate and protect the I&C electronics from current and voltage surges in the transmission lines. Each protection unit shall have:

- An isolation transformer with a minimum of 1,500 volts AC isolation, primary to secondary, and a minimum saturation current of 100 milliamps (ma) S.C. or as required to protect the I&C equipment from damage.
- Separate line-side and equipment-side terminal blocks.
- Two clip-mounted, replaceable gas discharge tubes rated at 90 volts striking voltage and 5,000 ampere peak pulse current capacity and suitable ground strap.

Part 2 - Products

Manufactured Units

The line protection unit shall be a complete unit, mounted on a separate chassis, and be field replaceable without soldering. The chassis shall be a 1/4-inch thick plate.

17.21.6 Line Protection Units – High Current

[CSI 40 78 56.17]

Part 1 - General

Design Requirements

The line protection unit shall isolate and protect the I&C electronics from current and voltage surges in the transmission lines. Each protection unit shall have:

- A minimum continuous operating current rating of 30 amps or larger as required to protect the telemetry equipment from damage.
- A minimum peak surge current rating of 80 KA.
- Separate line-side and equipment-side terminal blocks.
- LED indicator for circuit diagnostics.
- A response time less than or equal to 1 nanosecond.

The line protection unit shall be a complete unit available as a surface mount or DIN rail.

Part 2 - Products

Manufacturers

The line protector shall be an Allen-Bradley Model 4983-DC120-20 or equal.

17.22 Wire and Cable

[CSI 40 67 33]

17.22.2 Wiring

[CSI 40 67 33]

Part 1 - General

References

All electrical wiring shall be in accordance with the NEC.

Design Requirements

Wires shall be 600-volt class, PVC insulated, stranded copper and shall be the sizes required for the current to be carried but not less than No. 14 AWG conductor size.

Wires for signal circuits shall be twisted shielded pairs not smaller than No. 18 AWG.

Part 3 – Execution

Installation

All power wiring shall be supported on a sheet metal raceway or enclosed in a plastic wiring duct. Wiring for signal circuits shall be separated at least 6-inch from any power wiring.

17.22.3 Cables

[CSI 40 67 33]

Part 1 - General

Design Requirements

Cables and connectors shall be industry standard, shielded, and shall be provided to connect all peripherals and equipment.

17.30 INTELLIGENT CONTROL UNITS

17.31.2 Programmable Logic Controller (PLC) System

[CSI 40 63 43]

Part 1 - General

Summary

Work involved in this contract includes providing new PLC equipment and programming to provide the functions shown on the Plans and described herein.

Performance and Design Requirements

- The PLC system modifications shall accomplish the control requirements of the loop descriptions, Plans, and Specifications.
- The design application and installation of the PLCs shall conform to NEMA ICS 1.1.
- PLC programming shall be documented.
- All PLC control system components shall be capable of meeting or exceeding electromagnetic interference tests per ANSI/IEEE C37.90.2.

Part 2 – Products

Manufacturers

PLC components added to this Contract shall be Siemens. No substitution.

Refer to project Telemetry Panel plans for specific Siemens component numbers and quantities.

Components

Input/Output (I/O) Modules

- a) Provide plug-in modular-type I/O racks with cables to connect to all other required PLC system components.
- b) Provide I/O system with:
 1. I/O solid state boards with status lights indicating I/O status and board failure.
 2. Electric isolation between logic and field device.
 3. Interchangeable boards for similar I/O type to allow substitution of operating boards for failed units by the operator.
 4. Capability of withstanding low energy common mode transient to 1500 V without failure.
 5. Incorporate noise suppression design.
 6. Capable of meeting or exceeding surge-withstand capability tests, per ANSI/IEEE C37.90.1.
 7. Capable of meeting or exceeding electrical noise tests, NEMA ICS1-109.60-109.66.
- c) Discrete I/O modules:
 1. Interface to ON/OFF devices.
 2. I/O status indicator on module front.
 3. Voltage rating to match circuit voltage.
 4. Output module current rating:
 - a. Match maximum circuit current draw.

- b. Minimum 1.5 A/point for 120 V AC applications.
- 5. Isolated modules for applications where one module interfaces with devices utilizing different sources of power.
- 6. Individually fused outputs with blown fuse indication.
- d) Analog I/O modules:
 - 1. Input modules to accept signals indicated on Plans or Specifications.
 - 2. 12-bit minimum resolution.
 - 3. I/O chassis supplied power for powering connected field devices.
 - 4. Isolated (differential) inputs and outputs.
 - 5. User configurable for desired fault-response state.
 - 6. Provide output signals as indicated on Plans and Specifications.
 - 7. Individual D/A converter for each output module.
 - 8. Individual A/D converter for each input module.

Data Highway Communications

- 1. All PLC controllers shall be capable of Profinet and Profibus communications. Any additional industrial protocols shall be provided through protocol converters.

PLC Peripheral Devices

- 1. PLC Peripheral Devices

Graphical Operator Interface

- a. The data entry and display module shall consist of a 10-inch color screen display.
- b. The unit shall be capable of reading PLC data table register values and pre-defined messages and writing into PLC memory to modify register values.
- c. The readout module will be used as a local operator interface device for entering operational parameters and reading out process data including display of all alarms by tag number.
- d. A complete index of parameters and corresponding memory locations and a complete cross reference of alarms will be permanently attached to each PLC enclosure.
- e. The unit will be self-contained, 24 VDC powered and rated minimum NEMA 12 suitable for panel mounting.
- f. Communications will be direct with the Ethernet Switch via shielded CAT 5E Ethernet Cable.

Part 3 - Execution

Installers

Control System Integrator shall have had experience in design, installation, and start-up of at least three similar installations using the proposed hardware and software.

Installation

Provide a completely integrated distributed programmable controller system capable of analog and sequential control, data acquisition and display, alarm annunciation and communications using the PLC system. I/O cards and memory shall be added as necessary to complete work shown on the Plans and described in the specifications.

The system shall provide true distributed control wherein each PLC is an intelligent stand-alone controller programmed for the specific functions required at its respective location. Certain information in the form of control commands, interlocks and data will be passed directly between the PLCs for use in executing the local control programs.

Input/Output Connection Requirements

1. Make connections to I/O subsystem by terminating all field wiring on terminal blocks within the I/O enclosure.
2. Prewire I/O modules to terminal blocks.
3. Provide terminal blocks with continuous marking strip.
4. Size terminals to accommodate all active data base points and spares.
5. Provide terminals for individual termination of each signal shield.
6. Field wiring shall not be disturbed when removing or replacing an I/O module.

PLC Installment

1. Component placement:
 - a. Mount all components according to manufacturer's instructions.
 - b. Locate incoming line devices (isolation or constant voltage transformers, local power disconnects, surge suppressors, etc.) so as to keep power wire runs within an enclosure as short as possible.
 - c. If items such as magnetic starters, contactors, relays and other electromagnetic devices are located within the same enclosure as the PLC system components, provide at least 6 inches of separation between the magnetic area and the control area.
 - d. Oversize enclosure to accommodate future racks and auxiliary devices as required.
2. Provide enclosure with a single quick disconnect of incoming power. Mount disconnect switch or breaker on enclosure exterior and label.
3. Enclosures shall comply with these specifications.
4. Enclosures shall be equipped with H2S inhibitor(s) suitable for the enclosed volume.

17.33 Network Equipment and Computers

17.33.1 Industrial Network Equipment

[CSI 40 66 13]

Part 1 – General

Design Requirements

All specified “industrial network equipment” shall comply with the following minimum specifications:

1. Rated for a 5-30VDC power supply.
2. UL listed.
3. Designed for an industrial environment.
4. Operating temperature of -40 degrees Fahrenheit to 176 degrees Fahrenheit.
5. IP66 rated water and dust resistant.
6. Control network device shall be capable of remote monitoring using OPC protocol.
7. All devices on fiber backbone shall have a minimum of two sets of transmit/receive ports.
8. Twisted pair network speed shall be a minimum of 100Base-TX.
9. Fiber optic network speed shall be a minimum of 100Base-FX.

These requirements do not apply to non-industrial network equipment.

Part 2 - Products

Control Network Equipment

Data highway communications shall be accomplished on a control network consisting of nodes, one at each PLC or computer workstation and a physical link layer consisting of cables and all interfacing hardware. Control Network equipment shall consist of industrial Ethernet switches per City standards.

Part 3 – Execution

Installation

All network equipment in Control Panels shall be installed as per Plans, specifications and product installation instructions. All components shall be suitable for installation in the environment where installed. All devices shall be installed as specified by the manufacturer. All devices shall be installed to be field serviceable without taking the facility out of service. Device displays shall be positioned to be easily read when viewing directly into control panels.

17.50 SENSORS AND CONTROLS

[CSI 40 70 00]

17.50.1 Common Work for Sensors and Controls

[CSI 40 70 05]

Part 1 – General

Design Requirements

Provide sensors and controls scaled and rated for their intended application.

Part 3 – Execution

Installation

All devices shall be installed to be field serviceable without taking the facility out of service. Readouts shall be positioned to be easily read from a standing position, central to the room unless allowed otherwise by the Engineer.

17.51 Emergency Sensors and Controls

17.51.2 Smoke Detectors

[CSI 28 46 11]

Part 1 - General

Design Requirements

Provide all components suitable for installation in the environment where installed. Detector shall be provided complete with sensing head and mounting base.

The photoelectric smoke detector shall be 24-volt powered with a local audible alarm and Form C contacts for remote annunciation through two-wire connection to telemetry panel. The voltage requirement is dependent of the power source available at the telemetry panel. The detector shall detect both smoke particles and heat. The detectors shall have a latching alarm feature that resets only by a momentary power interruption.

Part 2 – Products

Manufacturers

The smoke detector shall be a System Sensor 4WTAR-B, or equal.

Part 3 – Execution

Examination

The Contractor shall verify power supply before selecting the appropriate model.

Site Testing

Test each smoke detector with artificial smoke in a can per manufacturer's instructions. Test the thermal sensing units with a heat gun or blow dryer per manufacturer's instructions.

Other testing methods will only be acceptable if approved by the manufacturer. Each failed smoke detector shall be replaced.

17.51.4 Intrusion Alarm Proximity Switch

[CSI 28 31 11.23]

Part 1 – General

Design Requirements

The switch shall be a magnetic proximity switch with one normally open and one normally closed set of contacts.

Part 2 – Products

Manufacturers

Intrusion switches shall be Turk magnetic, inductive, proximity switches. Provide model based on existing Tacoma Water standard.

Components

Provide with a standard box plug-in and connecting cable of significant length to reach a junction box located near the switch.

Part 3 – Execution

Installation

The Contractor shall install intrusion alarm switches on all entrance doors and access hatches as shown on the Plans. All components shall be suitable for installation in the environment where installed.

Mount the switch as shown on the Plans to detect the opening of each entrance door and access hatch identified on the Plans. Connect to the normally open contacts so that the switch is closed when the door is closed and open when the door is open. A factory provided cord shall be of significant length to reach from the device to a junction box.

17.51.5 Operator in Trouble (Panic) Alarm Button

[CSI 40 78 19.25]

Part 2 - Products

Manufacturers

Allen-Bradley, Eaton, Siemens, Square-D, or equal.

Materials

The pushbutton shall be heavy duty, oil-tight, push-pull mushroom type with contacts rated for 10 amps continuous at 24 VDC. Button color shall be red. Each pushbutton shall be furnished with a permanently mounted “Operator in Trouble – Push to Alarm” sign above the button. A junction box shall be provided for mounting.

Part 3 – Execution

Installation

The contractor shall install operator in trouble alarm buttons as shown on the Plans. Unless otherwise noted, mount device 48 inches above the floor. The alarm button when pushed shall transmit a signal into the telemetry for remote and local enunciation of an alarm condition. Each alarm button shall be wired in series to the input point at the telemetry panel.

17.52 Pressure and Level Sensors and Controls

[CSI 40 72 00, 40 73 00]

17.52.2 Flood Liquid Level Switches

[CSI 40 72 83]

Design Requirements

The switch shall be SPST rated for 20VA. The float shall be constructed on Buna-N material and the stem shall be constructed from brass.

Part 2 – Products

Manufacturers

Switches shall be Omega, LVN-20 or equal.

Part 3 – Execution

Installation

The contractor shall install a liquid level switch as shown on the Plans. Mount the switch to the end of ½-inch PVC Coated GRS or galvanized pipe, depending on the area classification. Provide threaded busing as necessary to provide a complete assembly. Secure pipe to wall with a minimum of two galvanized conduit hangers. Mount the liquid level assembly ½-inch above the finished floor.

17.52.4 Clean Water Level Float Switches

[CSI 40 72 76.15]

Part 2 – Products

Manufacturers

The float switch shall be an NSF Standard 61 rated Model SJE MilliAmpMaster Float as manufactured by SJE Rhombus, or equal.

Manufactured Units

Float switch body shall be constructed of high impact, corrosion resistant, polypropylene housing measuring not less than 2³/₄-inch in diameter. A long life, high reliability, potted SPST magnetic reed switch rated for not less than 100 VA at up to 250 Volts shall be mounted inside the float and connected to a multi-stranded, two (2) conductors plus ground, 18 gauge, CPE jacketed cable. The cord shall have fine strand conductors (Not more than 34 Gauge) made especially for heavy flexing service. The cable connection point shall be potted in epoxy providing a strong bond to the float and reed switch forming a water/moisture tight connection.

Part 3 – Execution

Installation

Level switches shall be normally closed type and provided for the following:

- Overflow level sensing

The Contractor shall provide a high level backup float. A flexible Neoprene sleeve, not less than 1/8-inch thick, shall be provided over the CPE jacketed cable extending not less than 5 inches from the top of the mounting bracket extending down through the cable mounting bracket hinge point to the top of the float switch body, providing cable stress point relief and extended operational life.

17.52.10 Gauge Pressure Transmitter

[CSI 40 73 26]

Part 1 – General

Design Requirements

Provide transmitter with 1/4-inch or 1/2-inch process connections, and completely suitable for measuring pressure in a potable water pipeline. Select ranges to provide a system that utilizes the largest percentage of available span for each transmitter. Transmitter shall transmit in pounds per square inch at both the device screen and through the 4-20mA output.

Location	Low end of range	High end of range (minimum)	High end of range (maximum)
Suction pressure	0 psi	50 psi	100 psi
Discharge pressure	0 psi	200 psi	400 psi
Reservoir Inlet/Outlet	0 psi	50 psi	100 psi

Part 2 – Products

Manufacturers

Pressure transmitter shall Turck PC010-Gi1/4A1M-LIAPN8X-H1141 or equal for the suction and reservoir inlet/outlet locations and Turck PC040-Gi1/4A1M-LIAPN8X-H1141 or equal for the discharge pressure location.

Manufactured Units

Water pressure transmitters shall be all solid state with a 4-20ma output. All wetted parts shall be stainless steel. Transmitter shall be hermetically sealed to withstand submergence or an operating environment of 100 percent humidity for an indefinite period of time. Total error band shall not exceed 0.25 percent of full scale over a temperature range of 0-100 degrees Celsius. Voltage input shall be 9 to 20 VDC without more than a 0.12 percent change in output. Volumetric displacement of bridge from 0 psi to max-rated pressure shall be less than 0.01 cubic inches. Provide electronics with built-in protection against AC line transients and lightning spikes, and an R/F filter to reject external electrical and internal noise. Zero and span adjustments shall be non-interacting.

A digital indicator with on-board pushbuttons shall be provided to display the measurement with a choice of units. The pushbuttons shall allow zero and span adjustments and local configuration without the need for a hand-held terminal.

Part 3 – Execution

Installation

Transmitter installations shall be equipped with drain and bleed and isolation valves to remove air from transmitter diaphragm. Contractor shall be completely responsible for proper operation and interface of transmitter with other electronics provided on the project.

17.52.11 Submersible Level Transmitter (Clean Water)

[CSI 40 72 43.21]

Part 1 – General

Design Requirements

The complete level transmitter assembly shall be completely rated for the environment for which it will be installed and shall be a totally submersible device with molded integral cable.

The transduction principle shall be an integrated silicon strain gauge bridge with a two-wire 4-20 mA output signal. Voltage input shall be 9 to 30 VDC.

The transmitter shall have stainless steel or titanium housing and shall be drinking water approved (NSF 61).

The transmitter shall have a maximum OD of 1 inch and a maximum length of 10 inches. The transmitter shall be provided with enough submergence-proof cable to allow for an unspliced run from the transmitter mounting depth to the control electronics plus 10 percent. The submergence-proof cable shall be constructed of polyurethane sheathed cable with integral vent tube and Kevlar strain cord.

Performance Requirements

The operating pressure range of the device shall be up to 100 feet with an overpressure acceptance of two times the rated pressure. Total error band shall not exceed 0.25 percent of full scale over a temperature range of 30 degrees to 86 degrees Fahrenheit. The accuracy shall be 0.1 percent of full scale for 1 psi to 900 psi range.

The electronics shall have built-in protection against AC line transients and lightning spikes and an RFI filter to reject internal electrical and internal noise.

Part 2 – Products

Manufacturers

The submersible level transmitter shall be a KPSI level transmitter 720 series, Endress-Hauser Waterpilot FMX167 (water application), GE (Druck) PTX 1830, or equal with cable hanger and either aneroid bellows or terminal box with filter.

Manufactured Units

Part 3 – Execution

Installation

The transmitter shall be installed in location as described on the Plans.

A weighted stainless $\frac{3}{16}$ -inch aircraft cable shall be provided for attachment of level transmitter. The aircraft cable with weight system shall be the length of the reservoir depth.

17.53 Environmental Sensors and Controls

17.53.2 Wall-Mounted Cooling Thermostat

[CSI 23 09 13.13]

Part 1 – General

Design Requirements

All components shall be suitable for installation in the environment where installed. The thermostat shall be a snap action, SPDT line voltage air switch controller rated for a 16-amp inductive load at 120 VAC.

Part 2 – Products

Manufacturer

The Wall-Mounted Cooling Thermostat shall be a Honeywell Model No. T775A2009 or equal with a -30 to 100-degree Fahrenheit range.

Part 3 – Execution

Installation

Furnish and install wall-mounted cooling thermostat as shown on the Plans. Mount thermostat 4 feet above finished floor in location shown on the Plans. Contractor shall set thermostat at 75 degrees Fahrenheit.

17.53.3 Wall-Mounted Heating Thermostat

[CSI 23 09 13.13]

Part 1 – General

Design Requirements

Provide a 24 volt, SPST wall mounted heating thermostat. All components shall be suitable for installation in the environment where installed. Thermostat shall be as recommended by the space heater manufacturer. Thermostat shall have an adjustable range from 40 to 100 degrees Fahrenheit. Set thermostat at 60 degrees Fahrenheit unless specified otherwise on the plans.

Part 2 – Products

Manufacturer

The wall-mounted heating thermostat shall be a Honeywell TH6110D1005, or equal.

Part 3 – Execution

Installation

Furnish and install wall-mounted thermostat as shown on the Plans. Mount thermostat 4 feet above finished floor in location shown on the Plans.

17.90 TESTING, STARTUP, AND TRAINING

17.90.1 Common Work for Testing, Startup, and Training

[CSI 40 61 21, 40 61 26, 40 80 00]

Part 1 – General

Summary

Total system hardware start-up is the responsibility of the Control System Integrator.

Maintenance

The Control System Integrator shall be solely and completely responsible for all hardware maintenance of the system from time of start-up to the date of acceptance, by formal action of the Owner, of all work under the contract. The Control System Integrator shall perform all such work required or considered to be required by the Owner to cause and maintain proper operation of the system and to properly maintain the system.

Warranty

The Contractor shall cause the Control System Integrator to make any and all repairs, replacements, modifications and adjustments required to eliminate any and all defects in design, materials and workmanship which are disclosed within the one year guarantee period. The Control System Integrator shall begin all repairs, replacements, modifications and adjustments within twenty-four (24) hours of notification by telephone by the Owner and shall complete such repairs, replacements, modifications and adjustments within forty-eight (48) hours of notification. Should the Control System Integrator fail to begin the work within 24 hours or complete the work within 48 hours, the Owner may proceed to undertake or complete the work. In such event, the Contractor and his surety shall be liable for all costs incurred by the Owner.

Part 3 – Execution

Field Quality Control

Equipment Manufacturer's Support

1. The Control System Integrator shall pay for services of equipment manufacturer's field service representative(s) to:
 - a. Inspect equipment covered by these Specifications.
 - b. Supervise adjustments and installation checks.
 - c. Conduct start-up of equipment and perform operational checks.
 - d. Provide Owner with a written statement that manufacturer's equipment has been installed properly, started up and is ready for operation by Owner's personnel.

Repairs

The Control System Integrator shall correct all deficiencies and defects and make any and all repairs, replacements, modifications, and adjustments as malfunctions or failures occur.

The Contractor and the Control System Integrator shall anticipate that the Owner may delay acceptance of all work under the contract if, in the judgment of the Owner, malfunctions or failures in operation of the control system repeatedly occur after start-up. Both the Contractor and the Control System Integrator shall not be entitled to an extension of time or to any claim for damages because of hindrances, delays or complications caused by or resulting from delay by the Owner in accepting the work because of malfunctions or failures in operation of the control system.

17.91 Tests and Inspections

[CSI 40 61 21, 40 80 13]

Part 1 - General

Summary

Materials, equipment, and construction included under this specification shall be inspected in accordance with the specifications. Testing shall be performed by the Control System Integrator in accordance with Division 16, and this and subsequent sections of this division.

Testing shall be required to determine if installed equipment and system(s) will operate in the manner in which they are intended to operate. The decision of the Owner upon the acceptability of the test procedures and conformance shall be final. The work will not be accepted until all testing has been satisfactorily performed.

Scheduling

The Contractor shall prepare factory and field test procedures to demonstrate conformance of the complete system to this specification. The Contractor shall submit the detailed test procedures within four weeks after the notice to proceed for the Engineer's review and approval.

The Contractor shall furnish all labor, materials, tools, equipment, instruments and services necessary to perform all specific functional testing of all installed equipment and systems at no additional cost.

The Control System Integrator and Contractor shall notify the Owner and Engineer of the factory testing date 30 days before testing.

Part 2 – Products

Factory Testing

All factory testing of control panels and computer systems shall be performed at the Control System Integrator's shop.

The completed control system shall be tested in the shop by the Control System Integrator. All motor control centers and VFD's supplied by the Control System Integrator shall be interconnected with the control system and powered with rated incoming voltage. Testing shall be conducted in two phases. The initial hardware testing shall include, but not be limited to, operation of all input and output (I/O) points, control devices and motor controllers. The subsequent testing shall include, but not be limited to, testing of RTU programming and Operator Interface provided by the Control System Integrator.

The initial hardware testing of the control system shall include the following:

1. The entire assembled panels shall be meggered and tested to be free from grounds and shorts.
2. Energize each discrete input and output and simulating each analog input and output using a loop simulator and calibrator. Circuits not energized shall be tested for continuity. Discrete input signals shall be tested in both the "on" and "off" state. Analog signals shall be tested at a minimum of three values (4 mA, 12 mA, and 20 mA). The test results shall be documented by the Control System Integrator in checklist format. The final test results shall be signed by both the Engineer and Control System Integrator prior to shipment of equipment to the job site.
3. Provide signal generators, multimeters, and other test equipment as required to verify proper operation of the assembled panels.
4. The Control System Integrator shall interconnect the control panels with the motor control centers and VFD's for both hardware and software testing phases. Control panels shall initially be hardware tested in one group. Similarly, the motor control

- centers and VFD's shall be hardware tested in another group. After both groups of hardware are confirmed to be operating correctly, the Control System Integrator shall interconnect the equipment with Ethernet cables and analog and discrete wiring as shown on the Plans. The equipment shall remain connected for the remainder of the factory testing period.
5. Correct, replace, or repair control panel and motor control center wiring, and/or components until testing demonstrates proper operation. Control panels and motor control centers shall not be shipped to the job site until testing has demonstrated complete operation of the panels.
 6. Provide updated and complete as-built drawings for the control panels and motor control centers at the time of final factory testing. The Engineer shall review the drawings against the panel construction at the time of final factory testing. Drawings which do not reflect the actual construction of the panel shall be revised and reviewed again by the Engineer. As-built drawings that require revisions shall be submitted to the Engineer for review prior to shipment of equipment to the job site. This review process shall be repeated as necessary so that as-built drawings reflect the actual construction of the panels and motor control centers at the time of shipment. Panels and motor control centers shall not be shipped to the job site until the as-built drawings are updated, complete, and reflect the actual as-shipped status of the equipment.

Upon completion of the initial hardware testing, Control System Integrator shall conduct software testing for final inspection by the Owner. The Control System Integrator shall provide for time, equipment and support in their shop for Control System Integrator to completely demonstrate the functions of the entire control system. All control functions and all status and alarm monitoring and indication shall be demonstrated under simulated operating conditions. Simulating equipment shall be provided and wired into the control system for this testing. Testing shall be continued for the time period required by the Owner to observe and verify any revisions and as described above in the scheduling portion of this specification.

Part 3 – Execution

Field Quality Control

Following installation by the Contractor, the Control System Integrator will verify the correctness of the interconnecting wiring and energize all control equipment in the field. Each point at the controller(s) shall be checked for proper functional operation through communication with the central computer.

Field Tests

The Control System Integrator in conjunction with the Contractor shall conduct field tests of all panels, motor control centers, VFD's, and instrumentation in the presence of the Engineer after installation of the equipment at the site. Testing shall be conducted by physically actuating signaling devices, installing temporary jumpers, or artificially imposing signals on the field wiring. This shall be done to establish proper operation of the field devices, the integrity of the field wiring, and the proper connection of field devices to the panels. The Contractor and

Control System Integrator shall coordinate with the Engineer to provide for as complete testing of the control system as is practical prior to placing the equipment on line for actual control and monitoring. The Contractor and Control System Integrator shall make corrections or repairs to the wiring and/or devices as necessary to provide proper operation of the system.

After the initial testing is complete, commissioning shall be accomplished by the Control Systems Integrator, and Contractor, with the Owner and Engineer present. Commissioning shall include operation and verification of all control components and features of the entire control system. Each function shall be demonstrated to the satisfaction of the Owner.

Repairs

Should any part of the system fail during the test, the test shall be rescheduled and repeated to the satisfaction of the Owner after repairs.

17.92 Startup

[CSI 40 80 15]

Part 1 – General

Summary

All testing, startup and operation shall not be cause for claims for delay by the Contractor, and all expenses accruing therefrom shall be deemed to be incidental to this contract. The Contractor shall make arrangement for all materials, supplies and labor necessary to efficiently complete the testing, startup and operation.

Startup shall consist of testing, by a simulated operation, all operational equipment and controls. The purpose of these tests shall be to check that all equipment will function under operating conditions, that all interlocking controls and sequences are properly set, and that the facility will function as an operating unit.

Scheduling

Factory representatives of all major units shall be present for the startup phase. The test shall continue until it is demonstrated that all functions of controls and machinery are correct.

Part 3 - Execution

Field Quality Control

When the installation of the Control System is substantially complete, the Contractor shall commence with calibration and field testing. Testing shall determine that all system components connect up correctly to each other so that the system works as designed. Refer to section 17.91 for field testing requirements.

All components of the control system shall be calibrated by the Control System Integrator after completion of installation. Each component shall be adjusted to be within the Manufacturer's required range and for the specific application.

Components that cannot be properly calibrated or that are found to exceed the Manufacturer's specified range or accuracy shall be removed and replaced at no additional cost to the Owner.

The control system shall be placed into operation by the Control Systems Integrator.

The Control System Integrator shall calibrate all instruments, indicators, recorders, loops, etc. and shall provide a five-point calibration test results sheet for each calibrated instrument supplied by the Control System Integrator. The five-point calibration shall include one point at: Minimum input range value, Maximum input range value, Midrange input value, no other point less than 25 percent of span to any other point. Test forms shall identify each instrument tested, input conditions vs. output signal results in tabulated form, and shall be submitted to the Engineer prior to final commissioning.

Repairs

All deficiencies observed during the start-up will be corrected by the Contractor.

17.93 Training

[CSI 40 61 26]

Part 1 – General

Submittals

Submit index of all training offered by PLC system equipment manufacturers including operation and maintenance.

The Control System Integrator 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.

Part 3 – Execution

Hands-On Training

The Control System Integrator shall conduct specifically organized training sessions in operation and maintenance of the control system 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 control system. 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

At least two separate training sessions, each at least 4 hours in duration, shall be conducted at the facility after start-up of the system.

17.94 Documentation

17.94.2 Operations and Maintenance Manuals

[CSI 40 80 23]

Part 1 – General

Summary

Two types of operation and maintenance manuals (O&M) will be required for the contract:

1. General manuals for use by the Water Department staff for daily operation, maintenance and troubleshooting.
2. Technical manuals for use by trained electronics technicians for technical and “board level” maintenance and repair.

Submittals

Prior to the receipt of payment for more than 50 percent of the work, the Contractor shall deliver to the Owner five sets of acceptable manufacturer's operating and maintenance instructions covering each piece of mechanical and electrical equipment, or equipment assembly, furnished under this contract. Each set of instructions shall be bound into multiple volumes; each volume to be complete with and index and bound in a suitable hard-cover binder. Manuals shall be assembled and indexed so that information on each piece of equipment can be readily found.

Quality Assurance

Manuals shall be purposefully made for this installation, and general manuals which are vague or have limited applicability will not be accepted. The manuals shall be written in a non-technical format suitable for reading by water system operators with no previous automatic control equipment experience. The decision of the Owner on the acceptability of the manual shall be final.

Part 2 – Products

Materials

The Control System Integrator shall prepare and assemble detailed operation and maintenance manuals in accordance with the project general requirements. The manuals shall include, but not be limited to, the following:

1. Name, location and phone number of nearest supplier and spare part warehouse.
2. Step by step operating procedures.
3. Narrative of overall system performance and operation.
4. Listing of all equipment setpoints.
5. Preventative maintenance procedures
6. Trouble-shooting of master and remote equipment.
7. Calibration
8. Testing

9. Replacement of components
10. System schematics / shop drawings
11. As-built elementary and one-line diagrams
12. Catalog data and complete parts list for all equipment and control devices
13. Listing of recommended spare parts.
14. Listing of recommended maintenance tools and equipment.
15. Warranties.
16. Disassembly and reassembly instructions.
17. Program documentation printout with tag numbers and descriptive comments.
18. Backup program on CD-ROM or flash drive.

All plans shall be provided on hard copy and in electronic form on disk. Electronic drawing files shall be provided in AutoCAD .DWG format with all "xrefs" bound. If "xrefs" are not bound, all "xref".DWG files shall be provided unlinked with instructions to reestablish the links. Files shall be in AutoCAD 2010 or later format.

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Division 18

Measurement and Payment

18.0 GENERAL

It is the intention of these specifications that performance of work under bid items shall result in complete construction, in proper operating condition, of improvements identified in these written specifications and accompanying plans. Work and material not specifically listed in the proposal, but required according to the plans and specifications and general practice, shall be included in Contractor's bid price.

Bid Item 1 – Packaged Booster Pump Station

Lump sum price shown shall cover the complete cost of providing all labor and materials necessary for a complete packaged booster pump station as shown on the Plans, and detailed in the contract specifications, including PE stamped approved shop drawings and structural calculations of the below grade booster pump station; structure and reinforcement; pumps; piping; access stairs and ladders; hatches; cranes; and appurtenances. This bid item specifically includes costs associated with the contractor obtaining the required insignia from Washington L&I. Specifically included in this bid item is factory testing of the complete packaged booster pump station and transport of the completed booster pump station to the project site. Payment shall be lump sum. Ten percent of the total bid item will be approved upon approval of the shop drawings, and 90 percent of the total bid price will be approved upon delivery of the pump station to the project site.

Bid Item 2 – Storage of Packaged Booster Pump Station

The unit price shown shall cover the complete cost of storing the completed packaged booster pump station at a facility chosen by the Contractor until delivery to the project site is requested. Payment shall be per calendar day the booster pump station is stored prior to shipping to the project site. In the event the actual time of storage is more or less than the estimated bid quantity or zero, no adjustment will be made to the unit price for this bid item.

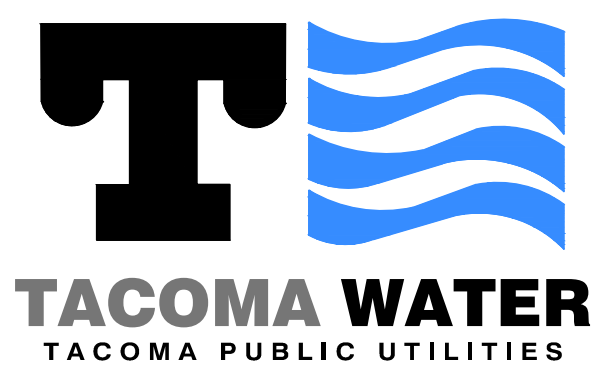
Bid Item 3 – Automatic Control (S&B Inc.) Package

Lump sum price shown shall cover the complete cost of providing all materials as included in S&B Inc.'s automatic control scope of work included in the appendices and labor as necessary to install the required components inside the packaged booster pump station. Payment will be lump sum.

Bid Item 4 – Testing, Startup, and Training

Lump sum price shown shall cover the complete cost of providing all labor and materials necessary for testing and startup of the packaged booster pump station once it has been installed by Others, as shown on the Plans, and detailed in the contract specifications. Payment shall be lump sum. Partial payment of up to 50 percent of the total bid item cost is allowed no earlier than after the first day of field testing. Final 50 percent of payment shall not be paid until testing of the station is complete, the pump station is completely operational, and staff trained as determined by the Owner and Engineer. Minimum cost for this bid item shall be \$5,000.

TACOMA WATER



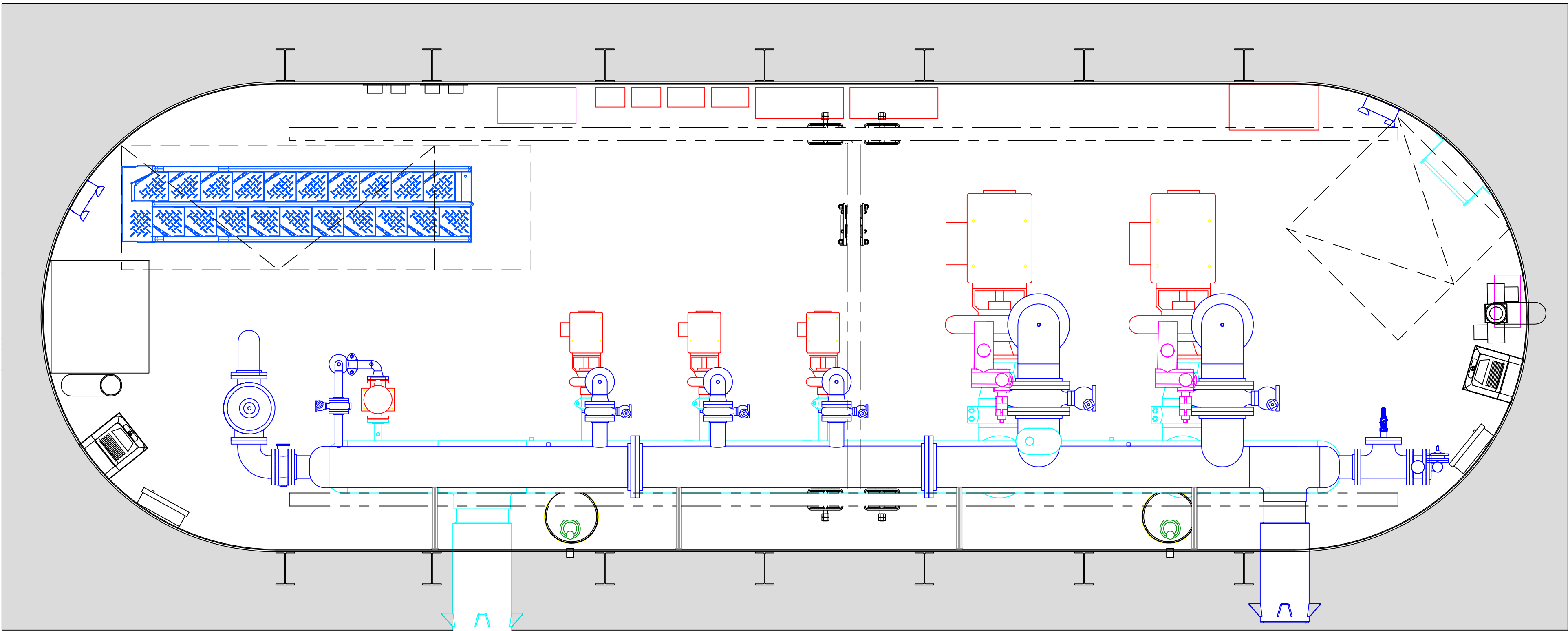
BONNEY LAKE 950/1010 ZONE BOOSTER PUMP STATION WINTER 2022

CONTACT INFORMATION

CONTACT	COMPANY	PHONE
CAROL POWERS, PE	TACOMA WATER	(253) 381-0200
MICHAEL WASHINGTON, PE	TACOMA WATER	(253) 502-8862
NON BUSINESS HOURS	TACOMA WATER	(253) 502-8344
MAX FREIMUND, PE	RH2 ENGINEERING	(425) 951-5315
TONY PARDI, PE	RH2 ENGINEERING	(425) 951-5312
24 HOUR LINE	PUGET SOUND ENERGY	1(888) 225-5773
24 HOUR LINE	PIERCE COUNTY SEWER	(253) 798-7000

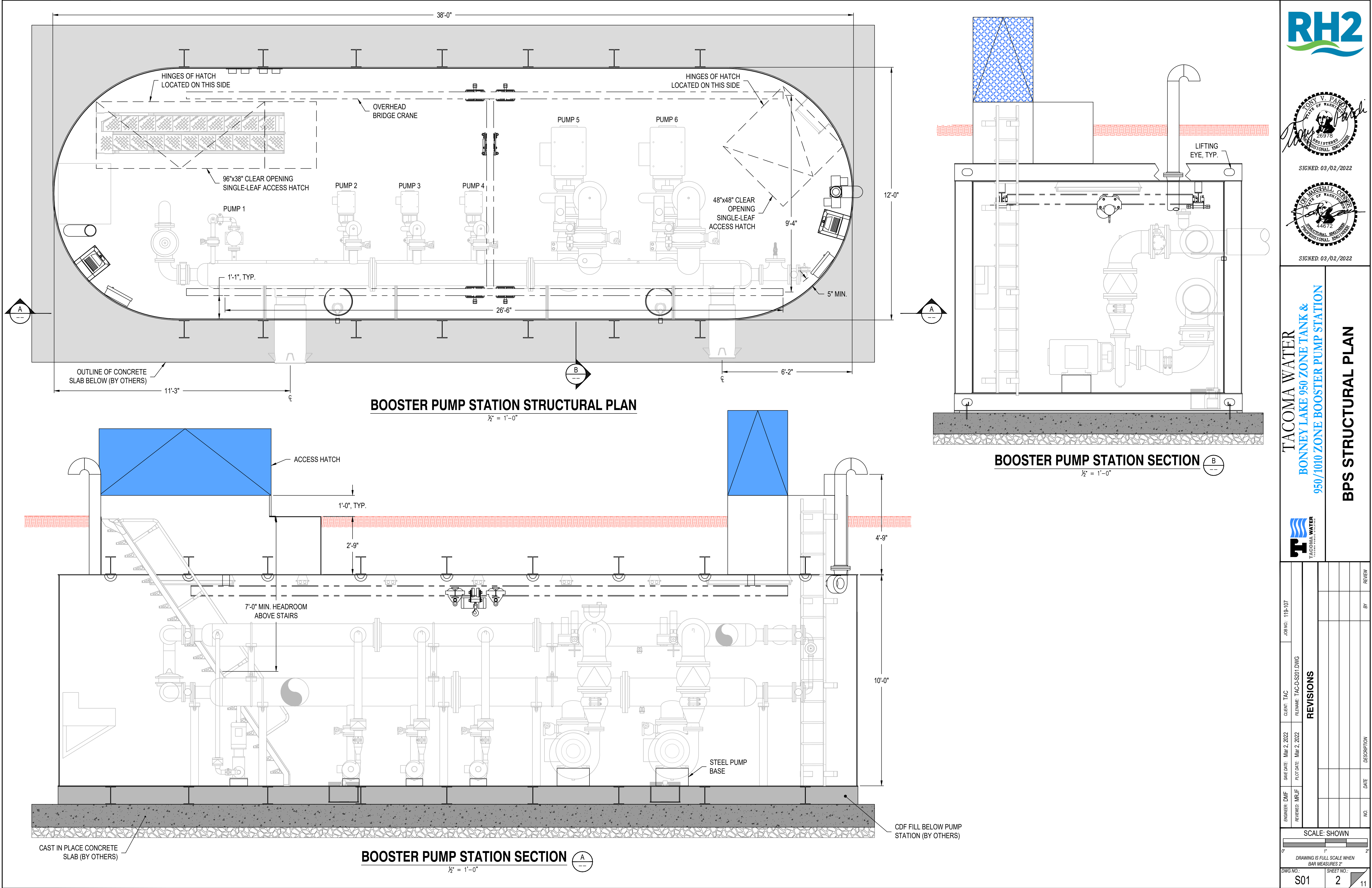
Sheet List Table

SHEET NO.	SHEET TITLE	DWG NO.
1	COVER	COV
2	BPS STRUCTURAL PLAN	S01
3	BOOSTER PUMP STATION MECHANICAL PLAN	M01
4	ELECTRICAL LEGEND	E01
5	ONE-LINE DIAGRAM	E02
6	BOOSTER PUMP STATION - POWER DISTRIBUTION AND SIGNAL PLAN	E03
7	BOOSTER PUMP STATION - LIGHTING, RECEPTACLE, AND GROUNDING PLAN	E04
8	CONTROL LOGIC DIAGRAMS	E05
9	ELECTRICAL DETAILS	E06
10	ELECTRICAL SCHEDULES	E07
11	CONDUIT AND CONDUCTOR SCHEDULES	E08



PREPARED BY:





TACOMA WATER

BONNEY LAKE 950 ZONE TANK & 950/1010 ZONE BOOSTER PUMP STATION

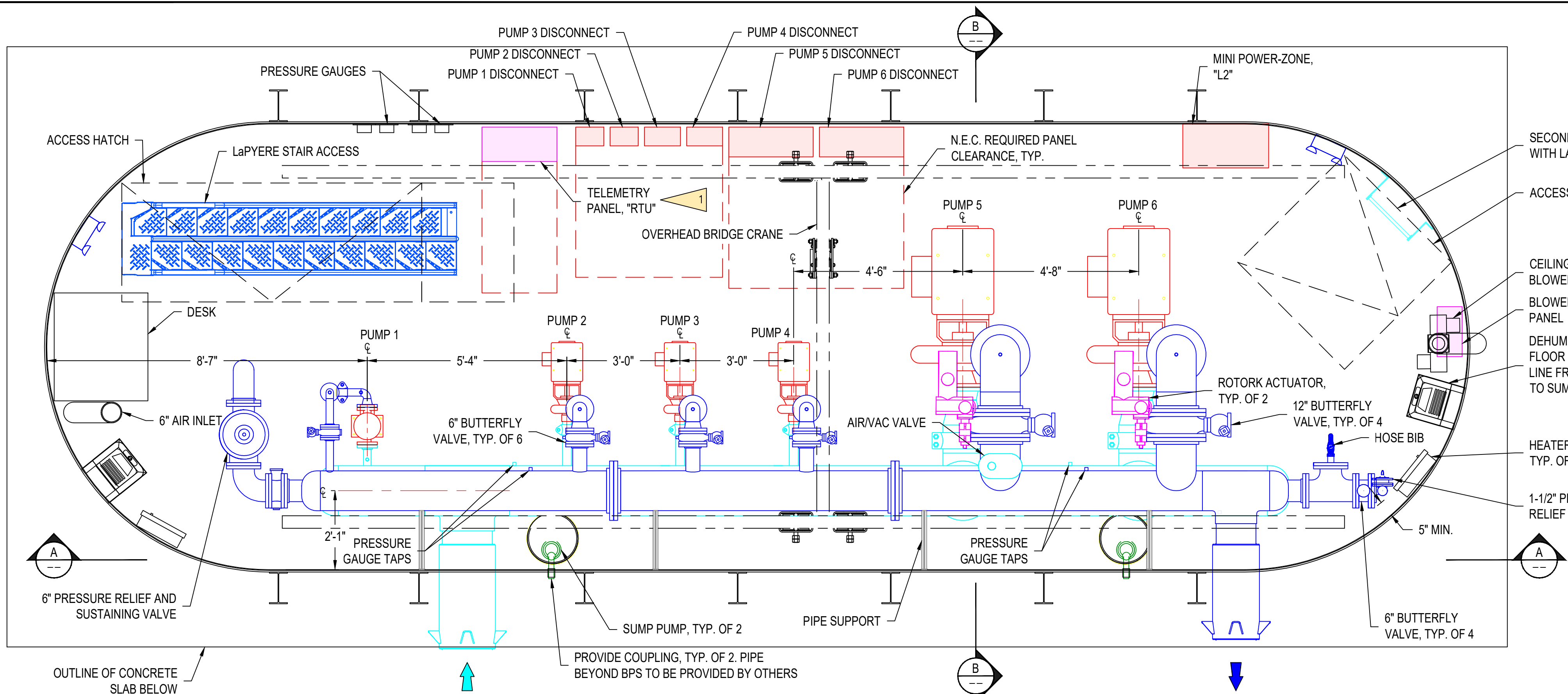
BPS STRUCTURAL PLAN

ENGINEER	DATE	REVISIONS	NO.	DATE	DESCRIPTION	BY	REVIEW
DMF	Mar 2, 2022						
MRJF	Mar 2, 2022						

SCALE: SHOWN

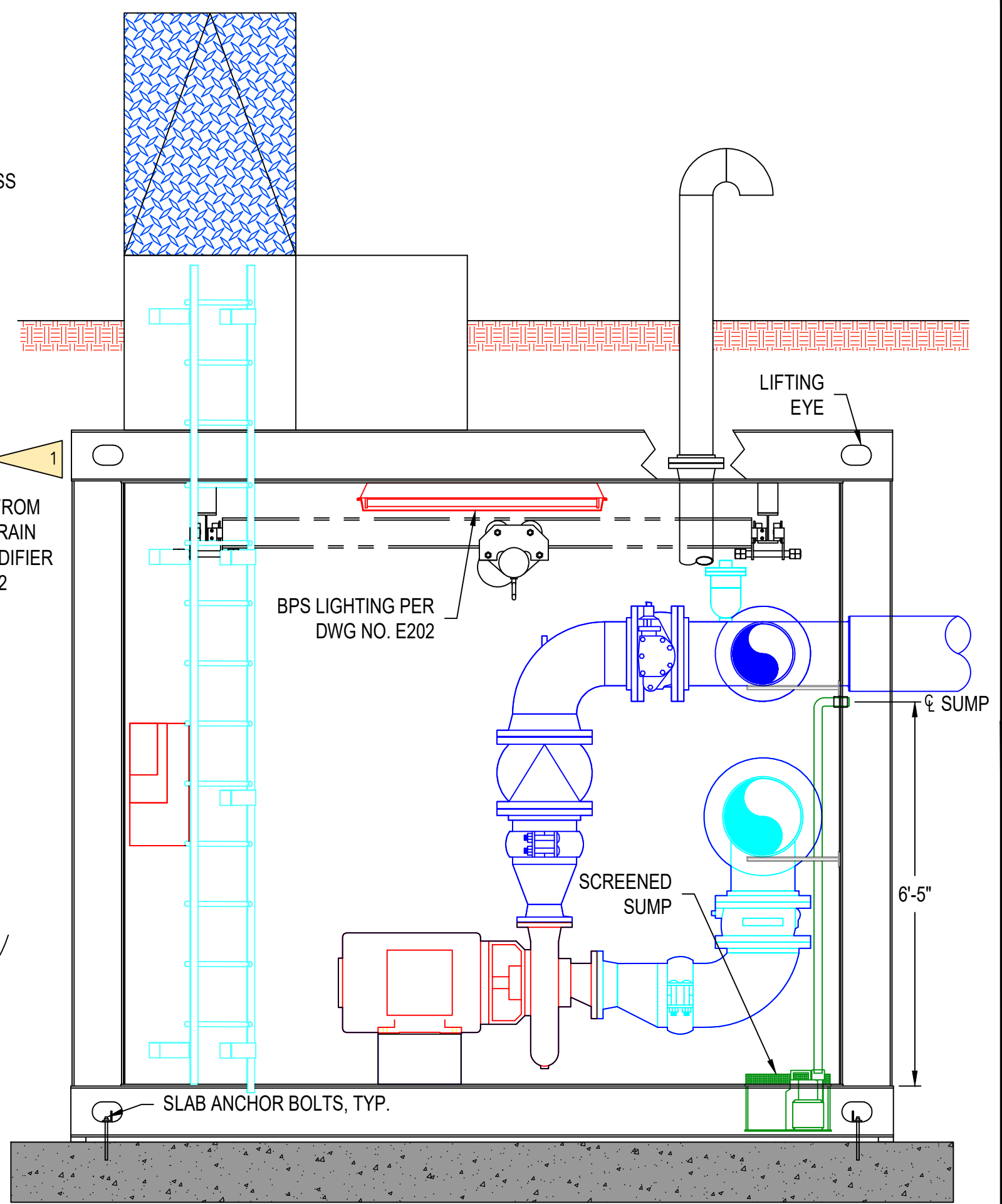
DRAWING IS FULL SCALE WHEN BAR MEASURES 2"

DWG NO.: S01 SHEET NO.: 2



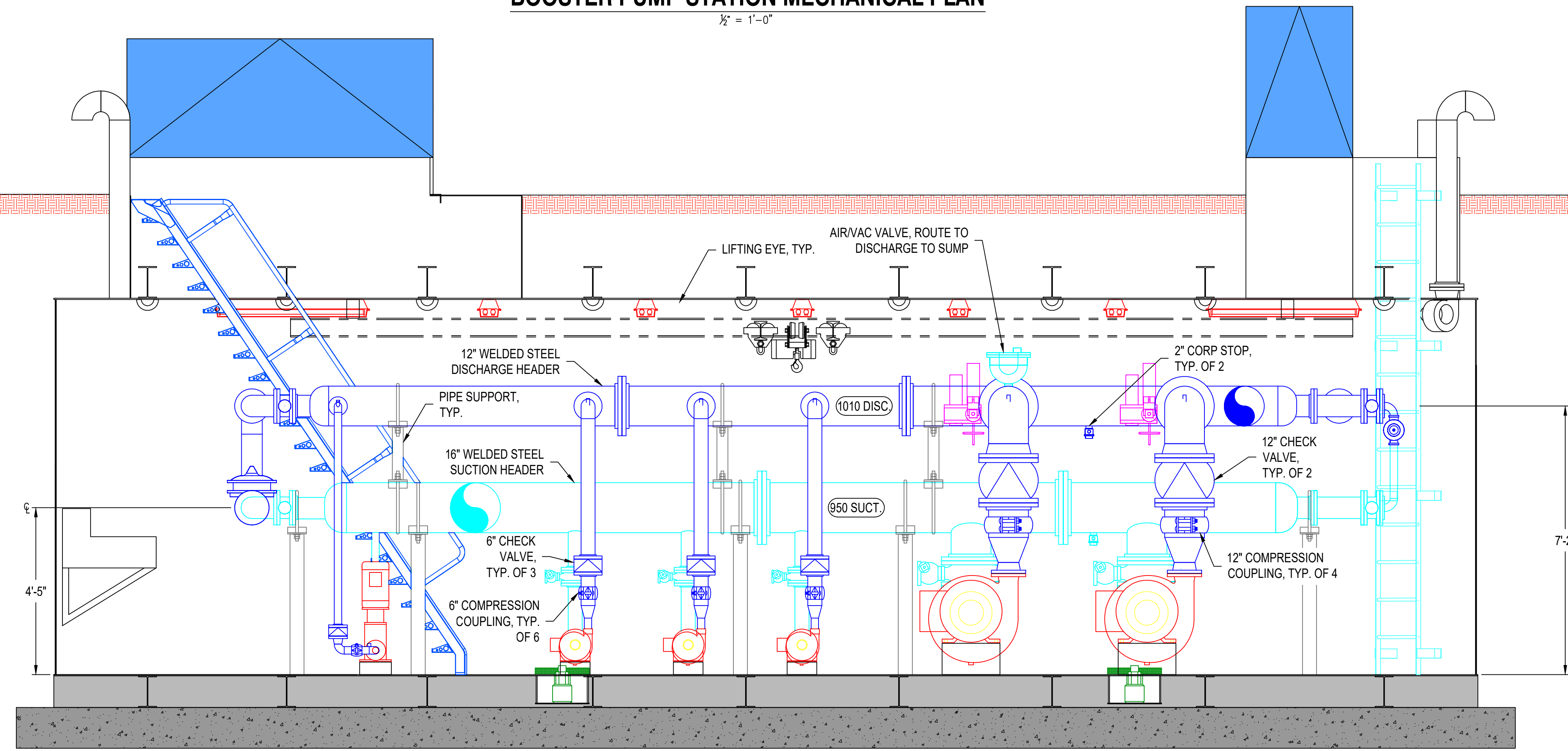
BOOSTER PUMP STATION MECHANICAL PLAN

1/2" = 1'-0"



BOOSTER PUMP STATION SECTION

1/2" = 1'-0"



NOTE: SUMP PUMP DISCHARGE PIPE NOT SHOWN THIS SECTION.

BOOSTER PUMP STATION SECTION

1/2" = 1'-0"

- NOTES**
1. EQUIPMENT TO BE PROVIDED BY S&B. UNLESS NOTED OTHERWISE, ALL OTHER EQUIPMENT SHOWN THIS SHEET TO BE PROVIDED BY BOOSTER PUMP STATION SUPPLIER.

PUMP SCHEDULE		
NO.	FLOW RATE (GPM)	TOTAL DYNAMIC HEAD (TDH)
PUMP 1	40	126'
PUMP 2	142	132'
PUMP 3	258	132'
PUMP 4	365	132'
PUMP 5	2300	162'
PUMP 6	2300	162'

TACOMA WATER

BONNEY LAKE 950 ZONE TANK & 950/1010 ZONE BOOSTER PUMP STATION

BOOSTER PUMP STATION MECHANICAL PLAN

NO.	DATE	DESCRIPTION	BY	REVIEW

ENGINEER: DMF
REVIEWED: MRJF


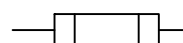
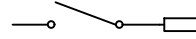
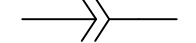

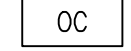
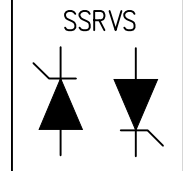
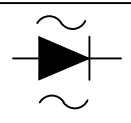


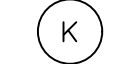
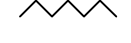

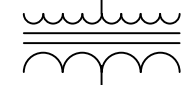
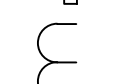
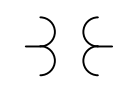
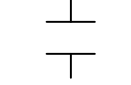
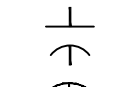

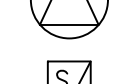
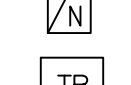
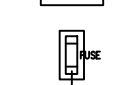


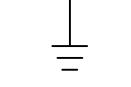
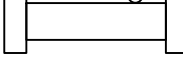

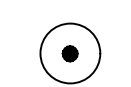

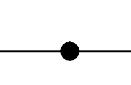
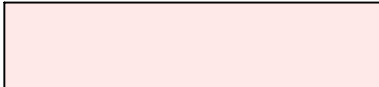

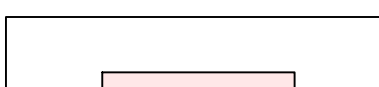


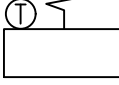

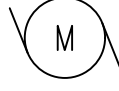






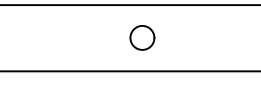

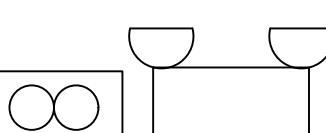





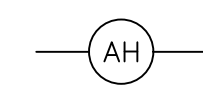













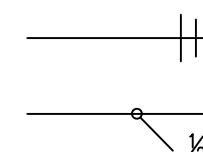
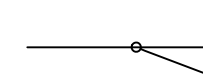
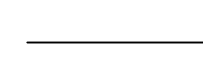
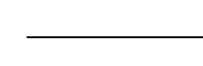
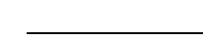
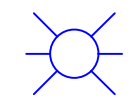
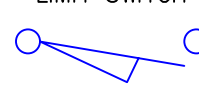
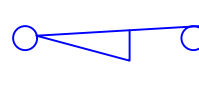



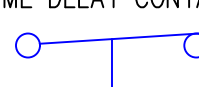

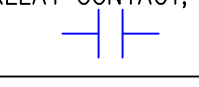
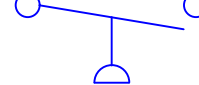
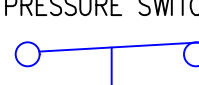
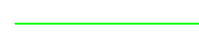



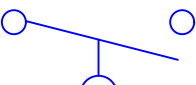
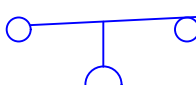
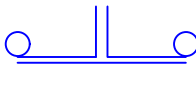
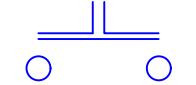



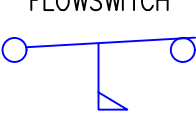
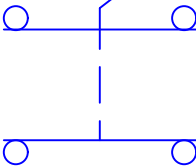
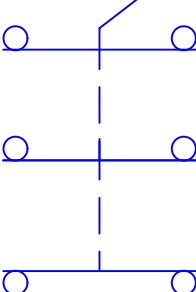
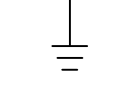
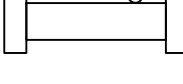

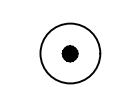

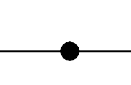

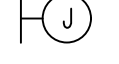


















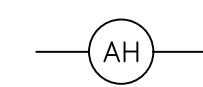













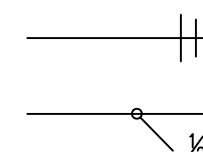
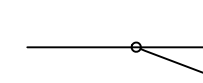
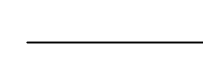
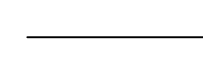
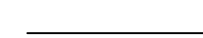
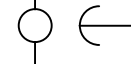
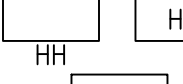
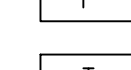
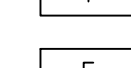
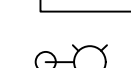
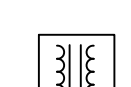
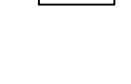

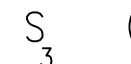

DATE: Mar 2, 2022
PLOT DATE: Mar 2, 2022

CLIENT: TAC
JOB NO.: 119-107
FILE NAME: PAC-D-MED02.DWG

SCALE: SHOWN

DRAWING IS FULL SCALE WHEN BAR MEASURES 2"

DWG NO.: M01
SHEET NO.: 3

ONE-LINE DIAGRAM SYMBOLS	PANELBOARDS, SWITCHES, AND EQUIPMENT	LIGHTING FIXTURES/DEVICES	ABBREVIATIONS		LADDER LOGIC SYMBOL LEGEND	
<div><div> CIRCUIT BREAKER xxx/yy – CB SIZE & NO. OF POLES ET – ELECTRONIC TRIP TM – THERMAL MAGNETIC BREAKER MCP – MOTOR CIRCUIT PROTECTOR SE – SERVICE ENTRANCE GFI – GROUND FAULT INTERRUPTER</div><div> FUSE</div><div> FUSED DISCONNECT SWITCH</div><div> PLUG-IN CONNECTION</div><div> RUN TIME METER</div><div> MOTOR OPERATION COUNTER</div><div> SSRVS – SOLID STATE REDUCED VOLTAGE STARTER</div><div> VARIABLE FREQUENCY DRIVE</div><div> MOTOR STARTER</div><div> MOTOR STARTER W/ OPERATOR DEVICES A – HAND-OFF-AUTO B – OPERATIONAL COUNTER C – RUN TIME METER D – RUN LIGHT E – FAIL LIGHT F – EMERGENCY STOP</div><div> KIRK KEY INTERLOCK</div><div> POWER TRANSFORMER</div><div> CONTROL POWER TRANSFORMER</div><div> TRANSFORMER</div><div> CURRENT TRANSFORMER</div><div> VOLTAGE TRANSFORMER</div><div> CONTACTOR</div><div> CAPACITOR</div><div> ENGINE GENERATOR</div><div> GENERATOR CONNECTION RECEPTACLE</div><div> SOLID NEUTRAL</div><div> TERMINAL BLOCK</div><div> SURGE PROTECTION DEVICE</div><div> SPD SURGE PROTECTION DEVICE (ALTERNATIVE)</div></div> <div><div> GROUND</div><div> METAL PIPE GROUND</div><div> CONNECTION POINT, EXOTHERMIC WELD, CADWELD OR APPROVED EQUAL.</div><div> GROUND ROD SIZED PER N.E.C. USE EXOTHERMIC WELD CONNECTION AT THE GROUND ROD.</div><div> PIGTAIL, BARE COPPER, LENGTH AS REQUIRED, 8" MINIMUM.</div><div> CONNECTION POINT, MECHANICAL, COMPRESSION TYPE.</div></div>	<div> SERVICE ENTRANCE, SWITCHGEAR, MOTOR CONTROL CENTER, OR PANELBOARD</div> <div> SURFACE MOUNTED PANELBOARD</div> <div> FLUSHED MOUNTED PANELBOARD</div> <div> NX FIELD CONTROL STATION WITH NEMA REQUIREMENTS: N1 – NEMA 1 N3R – NEMA 3R N4 – NEMA 4 N4SS – NEMA 4 STAINLESS STEEL N4F – NEMA 4 FIBERGLASS N6 – NEMA 6 N12 – NEMA 12 GASKETED</div> <div> EQUIPMENT MOUNTING STAND</div> <div> HEATER, WATTAGE NOTED</div> <div> EQUIPMENT CONNECTION</div> <div> SINGLE PHASE MOTOR, HORSEPOWER AS NOTED</div> <div> THREE PHASE MOTOR, HORSEPOWER AS NOTED</div> <div> SINGLE PHASE MOTOR, HORSEPOWER AS NOTED</div> <div> ELECTRICAL PLUG</div> <div> DISCONNECT SWITCH</div> <div> FUSED DISCONNECT SWITCH</div> <div> COMBINATION MOTOR STARTER AND DISCONNECT SWITCH</div>	<div> FLUORESCENT FIXTURE</div> <div> WALL/CEILING MOUNTED FIXTURE</div> <div> EMERGENCY LIGHT WITH SELF CONTAINED BATTERY</div> <div> SURFACE OR PENDANT MOUNTED FIXTURE</div> <div> RECESSED FIXTURE</div> <div> MOTION DETECTOR</div> <div> PHOTO CONTROL CELL</div>	<div><div>HOA – HAND-OFF-AUTO SWITCH RTM – RUN TIME METER OC – OPERATION COUNTER MRIL – MOTOR RUN INDICATION LIGHT SFIL – SEAL FAIL INDICATION LIGHT SFR – SEAL FAIL TRIP RESET OTIL – OVER TEMPERATURE INDICATION LIGHT MOIL – MOTOR OVERLOAD INDICATION LIGHT</div><div><div>INDICATE TYPE BY LETTER</div><div> V  AH</div><div>A – AMMETER AH – AMPERE-HOUR PF – POWER FACTOR V – VOLT METER VA – VOLT AMMETER</div><div>VAR – VAR METER VARH – VARHOUR METER W – WATT METER WH – WATTHOUR METER</div></div><div><div>RACEWAY LEGEND</div><div> P PROPOSED POWER</div><div> COMM PROPOSED COMMUNICATIONS</div><div> TELM PROPOSED INSTRUMENTATION</div><div> FO PROPOSED FIBER OPTICS</div><div><div>BUILDING OR FACILITY PLAN LEGEND</div><div> 480 VOLT EXPOSED RACEWAY</div><div> 480 VOLT WIRING CONCEALED, UNDERGROUND, EMBEDDED, OR CONCRETE ENCASED RACEWAY</div><div> 120/208/240 VOLT EXPOSED RACEWAY</div><div> 120/208/240V WIRING CONCEALED, UNDERGROUND, EMBEDDED, OR CONCRETE ENCASED RACEWAY</div><div> CONTROL OR INSTRUMENTATION EXPOSED RACEWAY</div><div> CONTROL OR INSTRUMENTATION, UNDERGROUND, EMBEDDED, OR CONCRETE ENCASED RACEWAY</div><div> HOME RUN TO PANELBOARD OR AS INDICATED</div><div> CONDUIT RUN, BROKEN AND CONTINUED SAME SHEET OR AS NOTED</div><div> FLEXIBLE CONDUIT</div><div> CONDUIT RUN. HATCH MARKS INDICATE NUMBER OF CONDUCTORS CALLOUT INDICATING CONDUIT SIZE, NUMBER AND SIZE OF WIRE.</div><div> XXX CALLOUT INDICATING CONDUIT PER SCHEDULE</div><div> CONDUIT BENT UP OR TOWARD</div><div> CONDUIT BENT DOWN OR AWAY</div><div> CAPPED CONDUIT</div></div></div></div>	<div><div>INDICATOR LIGHT</div><div> INDICATOR LIGHT A – AMBER B – BLUE C – CLEAR G – GREEN R – RED W – WHITE</div></div> <div><div>LIMIT SWITCH</div><div> LIMIT SWITCH, NORMALLY OPEN</div><div> LIMIT SWITCH, NORMALLY CLOSED</div></div> <div><div>TIME DELAY CONTACT</div><div> TIME DELAY CONTACT, NORMALLY OPEN, TIME TO CLOSE</div><div> TIME DELAY CONTACT, NORMALLY CLOSED, TIME TO OPEN</div><div> TIME DELAY CONTACT, NORMALLY OPEN, TIME TO OPEN</div><div> TIME DELAY CONTACT, NORMALLY CLOSED, TIME TO CLOSE</div></div> <div><div>RELAY CONTACT, NC</div><div> RELAY CONTACT, INSTANTANEOUS CHANGE</div><div><div>RELAY CONTACT, NO</div><div> RELAY CONTACT, NO</div></div><div><div>PRESSURE SWITCH</div><div> PRESSURE SWITCH, NORMALLY OPEN</div><div><div>PRESSURE SWITCH</div><div> PRESSURE SWITCH, NORMALLY CLOSED</div></div><div><div>LADDER LOGIC LINETYPES</div><div> COMPONENT INSTALLED INSIDE ENCLOSURE</div><div> COMPONENT INSTALLED ON FRONT OF ENCLOSURE</div><div> FIELD CONNECTED COMPONENT</div></div></div></div>	<div><div>RELAY</div><div> RELAY XYZ 123 RELAY TR – TIMED RELAY CR – CONTROL RELAY</div></div> <div><div>FLOAT SWITCH</div><div> FLOAT SWITCH, NORMALLY OPEN</div><div> FLOAT SWITCH, NORMALLY CLOSED</div></div> <div><div>PUSHBUTTON</div><div> PUSHBUTTON, NORMALLY CLOSED</div><div> PUSHBUTTON, NORMALLY OPEN</div></div> <div><div>THERMOSTAT</div><div> THERMO SWITCH, NORMALLY OPEN</div><div> THERMO SWITCH, NORMALLY CLOSED</div></div> <div><div>FLOWSWITCH</div><div> FLOWSWITCH, NORMALLY OPEN</div><div> FLOWSWITCH, NORMALLY CLOSED</div></div> <div><div>2 POLE SWITCH</div><div> 2 POLE SWITCH</div><div><div>3 POLE SWITCH</div><div> 3 POLE SWITCH</div></div></div>	
GROUNDING SYSTEM SYMBOLS	RECEPTACLES AND JUNCTION BOX SYMBOLS	FIRE SYSTEM SYMBOLS		RACEWAY LEGEND		
<div> GROUND</div> <div> METAL PIPE GROUND</div> <div> CONNECTION POINT, EXOTHERMIC WELD, CADWELD OR APPROVED EQUAL.</div> <div> GROUND ROD SIZED PER N.E.C. USE EXOTHERMIC WELD CONNECTION AT THE GROUND ROD.</div> <div> PIGTAIL, BARE COPPER, LENGTH AS REQUIRED, 8" MINIMUM.</div> <div> CONNECTION POINT, MECHANICAL, COMPRESSION TYPE.</div>	<div> CEILING JUNCTION BOX</div> <div> WALL JUNCTION BOX</div> <div> FLOOR JUNCTION BOX</div> <div> DUPLX WALL RECEPTACLE, 120V WP = WEATHERPROOF G = GROUNDED IG = ISOLATED GROUND GFI = GROUND FAULT INTERRUPTER</div> <div> DOUBLE DUPLX</div> <div> SINGLE RECEPTACLE, 120V</div> <div> SINGLE RECEPTACLE, 208V</div> <div> DUPLX FLOOR RECEPTACLE, 120V</div> <div> SPECIAL PURPOSE WALL RECEPTACLE, RATING AS NOTED</div> <div> CLOCK</div> <div> TELEVISION</div> <div> TELEPHONE</div> <div> TELEPHONE/DATA WITH CABLE</div> <div> TELEPHONE/DATA WITHOUT CABLE</div>	<div> HEAT DETECTOR</div> <div> SMOKE DETECTOR</div> <div> FIRE ALARM DISPATCH STROBE ALARM</div> <div> FIRE ALARM AUDIBLE/VISUAL ALARM</div> <div> FIRE ALARM MANUAL PULL STATION</div>	<div><div>INDICATE TYPE BY LETTER</div><div> V  AH</div><div>A – AMMETER AH – AMPERE-HOUR PF – POWER FACTOR V – VOLT METER VA – VOLT AMMETER</div><div>VAR – VAR METER VARH – VARHOUR METER W – WATT METER WH – WATTHOUR METER</div></div> <div><div>RACEWAY LEGEND</div><div> P PROPOSED POWER</div><div> COMM PROPOSED COMMUNICATIONS</div><div> TELM PROPOSED INSTRUMENTATION</div><div> FO PROPOSED FIBER OPTICS</div><div><div>BUILDING OR FACILITY PLAN LEGEND</div><div> 480 VOLT EXPOSED RACEWAY</div><div> 480 VOLT WIRING CONCEALED, UNDERGROUND, EMBEDDED, OR CONCRETE ENCASED RACEWAY</div><div> 120/208/240 VOLT EXPOSED RACEWAY</div><div> 120/208/240V WIRING CONCEALED, UNDERGROUND, EMBEDDED, OR CONCRETE ENCASED RACEWAY</div><div> CONTROL OR INSTRUMENTATION EXPOSED RACEWAY</div><div> CONTROL OR INSTRUMENTATION, UNDERGROUND, EMBEDDED, OR CONCRETE ENCASED RACEWAY</div><div> HOME RUN TO PANELBOARD OR AS INDICATED</div><div> CONDUIT RUN, BROKEN AND CONTINUED SAME SHEET OR AS NOTED</div><div> FLEXIBLE CONDUIT</div><div> CONDUIT RUN. HATCH MARKS INDICATE NUMBER OF CONDUCTORS CALLOUT INDICATING CONDUIT SIZE, NUMBER AND SIZE OF WIRE.</div><div> XXX CALLOUT INDICATING CONDUIT PER SCHEDULE</div><div> CONDUIT BENT UP OR TOWARD</div><div> CONDUIT BENT DOWN OR AWAY</div><div> CAPPED CONDUIT</div></div></div>			
ELECTRICAL SITE PLAN SYMBOLS	SWITCH OUTLETS		GENERAL NOTES			
<div> UTILITY POLE AND GUY WIRE</div> <div> HH MANHOLE OR HANDHOLE</div> <div> P BURIED POWER VAULT OR MANHOLE</div> <div> T TELEPHONE VAULT OR PEDESTAL</div> <div> F FIBER OPTICS VAULT OR PEDESTAL</div> <div> LUMINAIRE</div> <div> PAD-MOUNT TRANSFORMER</div>	<div> S \$ STANDARD SWITCH, 120VAC, 20 AMP</div> <div> S 3 \$ 3-WAY SWITCH, 120VAC, 20 AMP</div> <div> S HOA \$ HOA 3-POSITION SWITCH, 120VAC, 20 AMP, LABEL SWITCH POSITION HAND-OFF-MOTION OR PHOTO</div> <div><div><div>S DEE S 2 S 3 S 4 S D S OS</div><div>SINGLE-POLE DOUBLE-POLE THREE WAY FOUR WAY DIMMER OCCUPANCY SENSOR</div></div><div><div><div>S P S K S LV S M</div><div>PILOT-LIGHTED KEY-OPERATED LOW VOLTAGE MASTER PUSHBUTTON</div></div></div></div>	<div><div>GENERAL NOTES</div><div>1. THIS IS A STANDARD LEGEND. NOT ALL OF THE INFORMATION SHOWN ON THIS PAGE WILL APPEAR IN THIS SET OF PLANS.</div><div>2. THESE DRAWINGS ARE DIAGRAMMATIC ONLY; EXACT LOCATIONS OF ELECTRICAL EQUIPMENT SHALL BE DETERMINED IN THE FIELD BY THE CONTRACTOR. THE INSTALLATION OF ALL EQUIPMENT SHOWN ON THESE DRAWINGS OR DESCRIBED IN THE SPECIFICATIONS SHALL CONFORM TO THE REQUIREMENTS SET FORTH IN THE LATEST EDITIONS OF ALL APPLICABLE CODES AND UTILITY COMPANY STANDARDS. CONTACT THE UTILITY COMPANY REPRESENTATIVES AND VERIFY THEIR REQUIREMENTS.</div><div>3. NOTIFY THE ENGINEER IMMEDIATELY IF CONFLICTS IN EQUIPMENT LOCATIONS ARE DISCOVERED OR IF PROBLEMS ARISE DUE TO FIELD CONDITIONS, LACK OF INFORMATION OR ANY OTHER REASON. NO PAYMENT WILL BE MADE FOR CHANGES WHICH HAVE NOT BEEN REVIEWED BY THE ENGINEER.</div></div>				

ENGINEER: KES

REVIEWED: CMR

SAVE DATE: Mar 1, 2022

PLOT DATE: Mar 2, 2022

CLIENT: TAC

RENAME: TAC-DELECO1.DWG

JOB NO.: 1109-107

REVISIONS

NO.

DATE

BY

REVIEW

SCALE: SHOWN

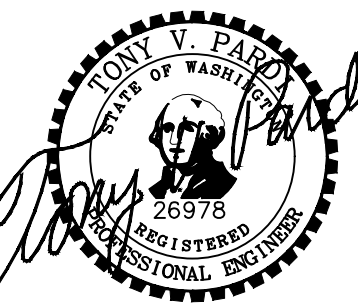
DWG NO.: E01

SHEET NO.: 4

RH2

STATE OF WASHINGTON
PROFESSIONAL ENGINEER
NO. 26978
EXPIRATION DATE 12/31/2025

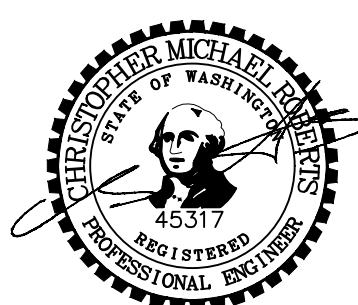
SIGNED: 03/02/2022



CHRISTOPHER MICHAEL PARKS

STATE OF WASHINGTON
PROFESSIONAL ENGINEER
NO. 45317
EXPIRATION DATE 12/31/2025

SIGNED: 03/02/2022



TACOMA WATER

BONNEY LAKE 950 ZONE TANK &
950/1010 ZONE BOOSTER PUMP STATION

ELECTRICAL LEGEND

ADDITIONAL SYMBOLS


S
SOUND SYSTEM SPEAKER


V
SOUND SYSTEM VOLUME CONTROL


B
DOORBELL

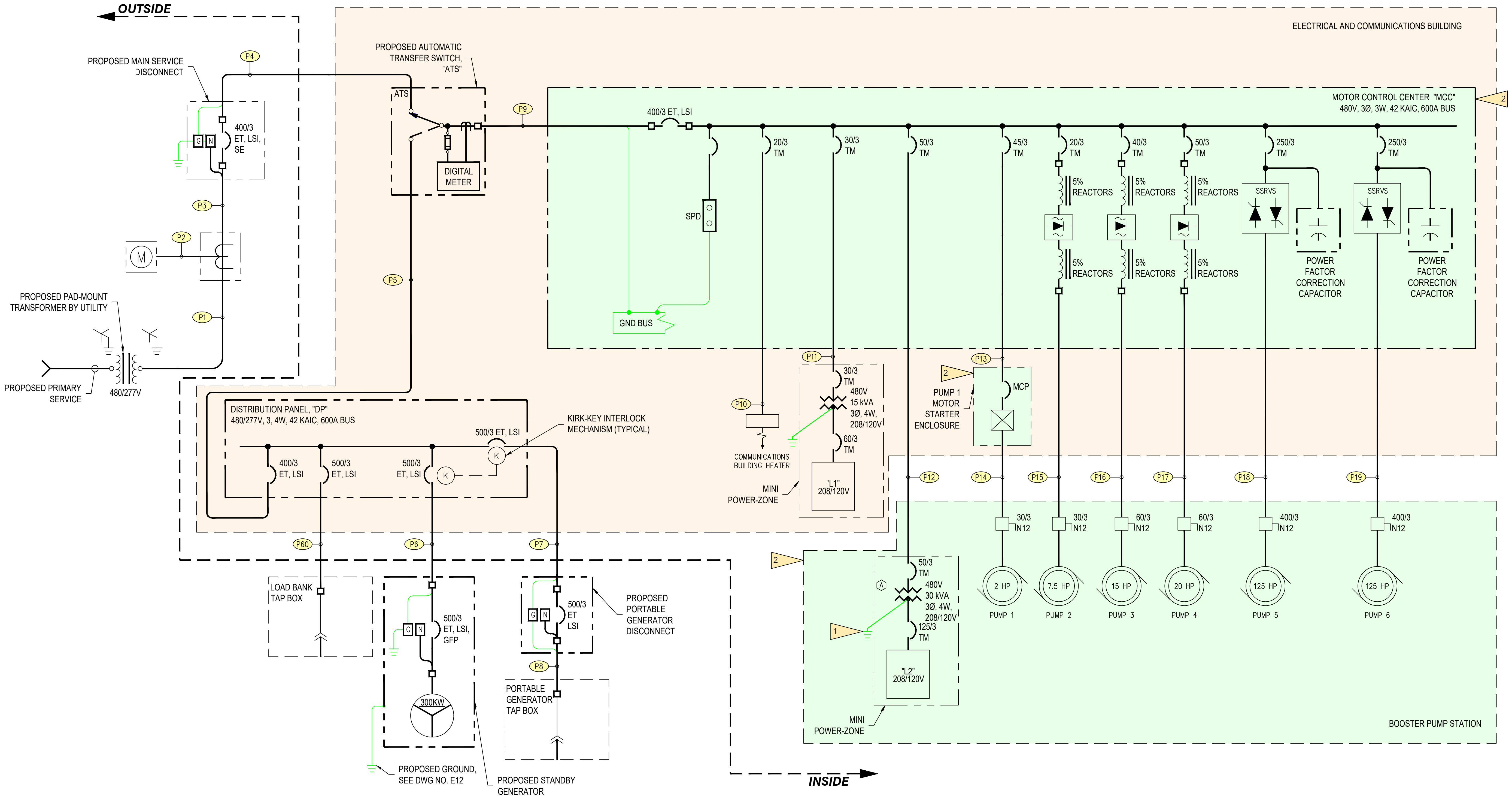
VALVE SYMBOLS


PILOT VALVE SOLENOID


VALVE

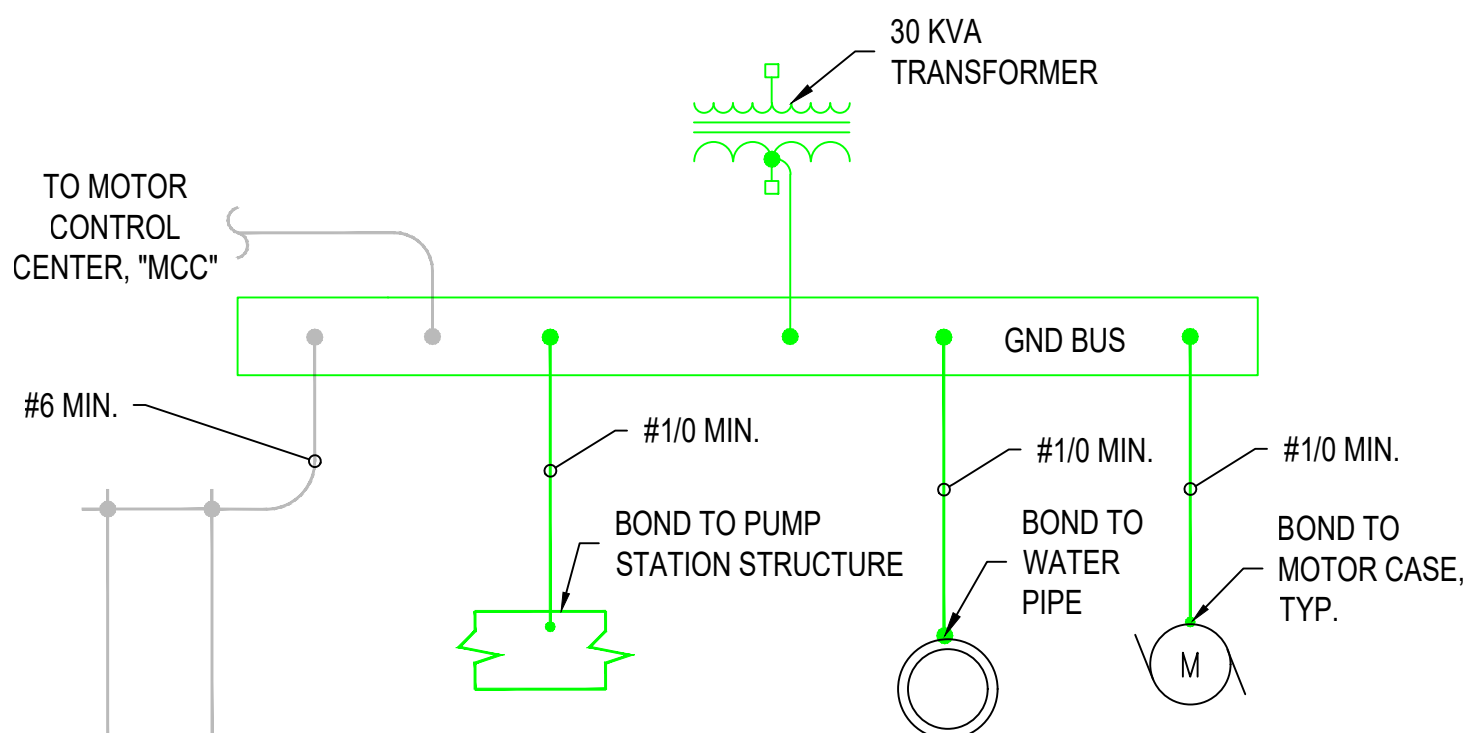

CHECK VALVE


CONTROL VALVE



ONE-LINE DIAGRAM
NOT TO SCALE

ELECTRICAL NOTES	
1	1. SEE GROUNDING DETAIL, THIS SHEET.
2	2. EQUIPMENT SHOWN IN GREEN BOXES WILL BE PROVIDED BY PUMP STATION SUPPLIER. ALL OTHER EQUIPMENT TO BE PROVIDED BY OTHERS.
XX	3. SEE DWG NO. E08 FOR CONDUIT AND CONDUCTOR SCHEDULE.
X	4. SEE DWG NO. E07 FOR ELECTRICAL EQUIPMENT SCHEDULE.



STATION LOAD CALCULATIONS			
PUMP 1 (2 HP)	3.4A X 0.00 =	0.00 AMPS	
PUMP 2 (7.5 HP)	11.0A X 0.00 =	0.00 AMPS	
PUMP 3 (15 HP)	21.0A X 0.00 =	0.00 AMPS	
PUMP 4 (20 HP)	27.0A X 0.00 =	0.00 AMPS	
PUMP 5 (125 HP)	156.0A X 0.00 =	0.00 AMPS	
PUMP 6 (125 HP)	156.0A X 1.25 =	195.0 AMPS	
MINI POWER-ZONE, "L1" (3 PHASE, 15 kVA)	18.0A X 1.00 =	18.04 AMPS	
COMMUNICATIONS BUILDING HEATER (3 kW)	3.6A X 1.00 =	3.6 AMPS	
MINI POWER-ZONE, "L2" (3 PHASE, 30 kVA)	36.1A X 1.00 =	36.1 AMPS	
TOTAL		252.7 AMPS	

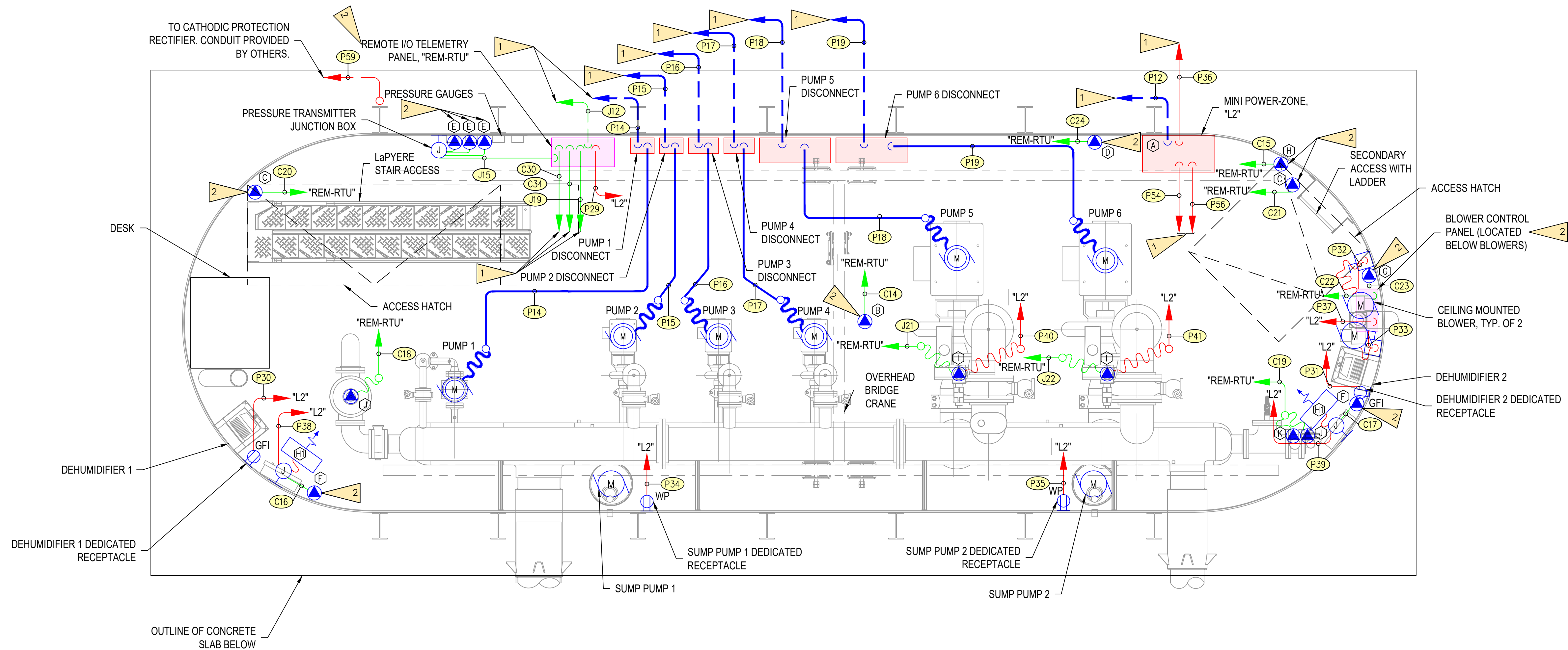
TACOMA WATER
BONNEY LAKE 950 ZONE TANK & 950/1010 ZONE BOOSTER PUMP STATION
ONE-LINE DIAGRAM

ENGINEER: KES	DATE: Mar 1, 2022	CLIENT: TAC	LOG NO.: 119-107	REVIEW
REVIEWED: CWR	DATE: Mar 2, 2022	FILENAME: TAC-D-ELEC02.DWG		BY
				DATE
				NO.
				DESCRIPTION

SCALE: SHOWN

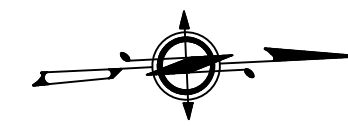
DRAWING IS FULL SCALE WHEN BAR MEASURES 2"

DWG NO.: E02 SHEET NO.: 5



BOOSTER PUMP STATION - POWER DISTRIBUTION AND SIGNAL PLAN

1/2" = 1'-0"



ELECTRICAL NOTES

1. ALL CONDUITS ENTERING THE BOOSTER PUMP STATION FROM OUTSIDE THE PUMP STATION SHALL BE PROVIDED BY OTHERS VIA A SEPARATE CONTRACT. BOOSTER PUMP STATION SUPPLIER TO PROVIDE PRE-INSTALLED CONDUIT PENETRATIONS/SLEEVES IN BOOSTER PUMP STATION WALL FOR OTHERS TO USE FOR INSTALLATION OF CONDUITS.
2. EQUIPMENT TO BE PROVIDED BY S&B. ALL OTHER EQUIPMENT TO BE PROVIDED BY BOOSTER PUMP STATION SUPPLIER.
3. SEE DWG NO. E08 FOR CONDUIT AND CONDUCTOR SCHEDULE.
4. SEE DWG NO. E07 FOR ELECTRICAL EQUIPMENT SCHEDULE.
5. SEE DWG NO. E07 FOR HEATER SCHEDULE.
6. ALL CONDUITS AND CONDUCTORS INTERNAL TO THE BOOSTER PUMP STATION THAT DO NOT LEAVE THE INTERIOR OF THE BOOSTER PUMP STATION SHALL BE PROVIDED AND INSTALLED BY THE BOOSTER PUMP STATION SUPPLIER.

SIGNED: 03/02/2022

SIGNED: 03/02/2022

LOG NO.: 119-107
CLIENT: TAC
FILE NAME: TAC-D-ELEC03.DWG

ENGINEER: KES
REVIEWED: CMR

DATE: Mar 2, 2022
PLOT DATE: Mar 2, 2022

REVISIONS

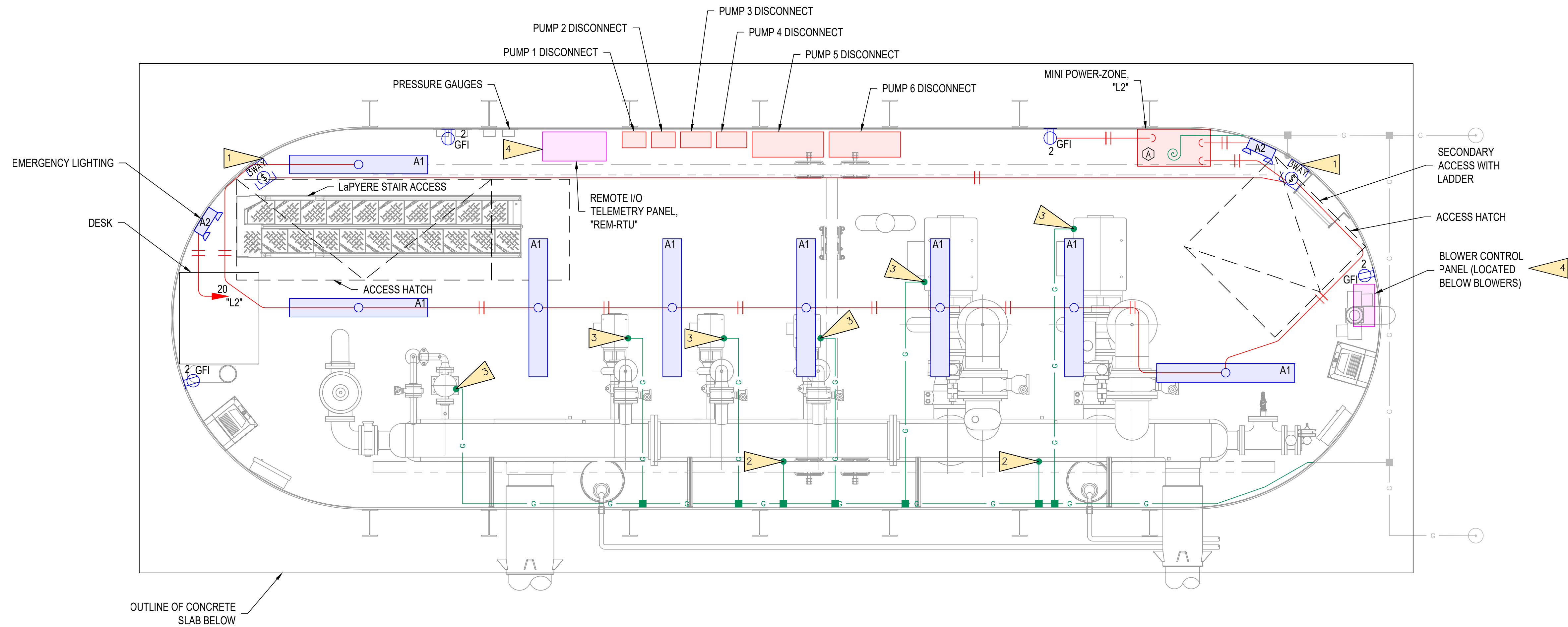
NO.	DATE	DESCRIPTION	BY	REVIEW

SCALE: SHOWN

DRAWING IS FULL SCALE WHEN
BAR MEASURES 2"

DWG NO.:
E03

SHEET NO.:
6

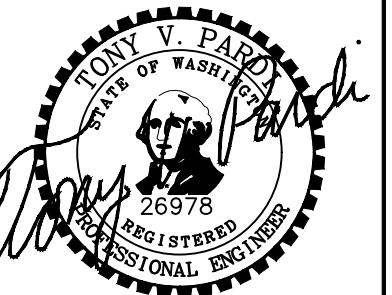
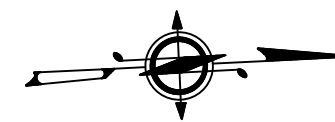


ELECTRICAL NOTES

1. SINGLE GANG BOX AND SWITCH SURFACE MOUNTED TO WALL.
2. BOND GROUND SYSTEM TO WATER PIPING (TYPICAL OF 2 LOCATIONS).
3. BOND GROUND SYSTEM TO MOTOR CASING.
4. EQUIPMENT TO BE PROVIDED BY S&B. ALL OTHER EQUIPMENT TO BE PROVIDED BY BOOSTER PUMP STATION SUPPLIER.
- A# 5. SEE DWG NO. E07 FOR LIGHTING FIXTURE SCHEDULE.
- (X) 6. SEE DWG NO. E07 FOR ELECTRICAL EQUIPMENT SCHEDULE.
7. PROVIDE AND INSTALL LABELS FOR ALL LIGHT SWITCHES. LABELS SHALL INDICATE THE DEVICE CONTROLLED BY THE SWITCH.
8. LOCATE ALL LIGHT FIXTURES, SWITCHES, AND DEVICES IN LOCATION SHOWN ON THE PLANS USING ENGINEERING SCALE. ADJUST LOCATION AS NECESSARY TO AVOID INTERFERENCE WITH OTHER EQUIPMENT.
9. BOOSTER PUMP STATION SUPPLIER IS RESPONSIBLE FOR INTERNAL GROUNDING CONNECTIONS. OTHERS ARE RESPONSIBLE FOR EXTERNAL GROUND RODS AND ELECTRODE CONDUCTOR TO THE GROUND BUS INSIDE THE BOOSTER PUMP STATION. BOOSTER PUMP STATION SUPPLIER TO PROVIDE CONDUIT PENETRATIONS/SLEEVES IN BOOSTER PUMP STATION WALL FOR GROUND ELECTRODE CONDUCTORS.

BOOSTER PUMP STATION - LIGHTING, RECEPTACLE, AND GROUNDING PLAN

1/2" = 1'-0"



SIGNED: 03/02/2022



SIGNED: 03/02/2022

TACOMA WATER
BONNEY LAKE 950 ZONE TANK &
950/1010 ZONE BOOSTER PUMP STATION

**BOOSTER PUMP STATION - LIGHTING,
RECEPTACLE, AND GROUNDING PLAN**



LOG NO.: 119-107

CLIENT: TAC

DATE: Mar 1, 2022

ENGINEER: KES

REVISIONS

DWG NO.: E04

SHEET NO.: 7

11

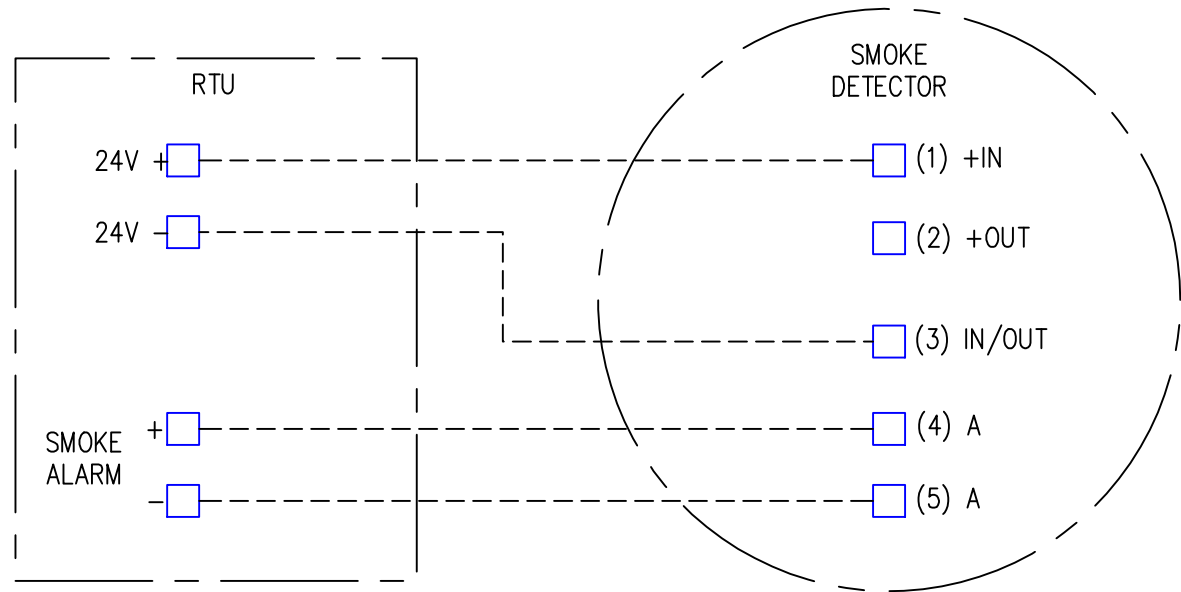


DIAGRAM 1: BPS SMOKE DETECTOR CIRCUIT

NO SCALE

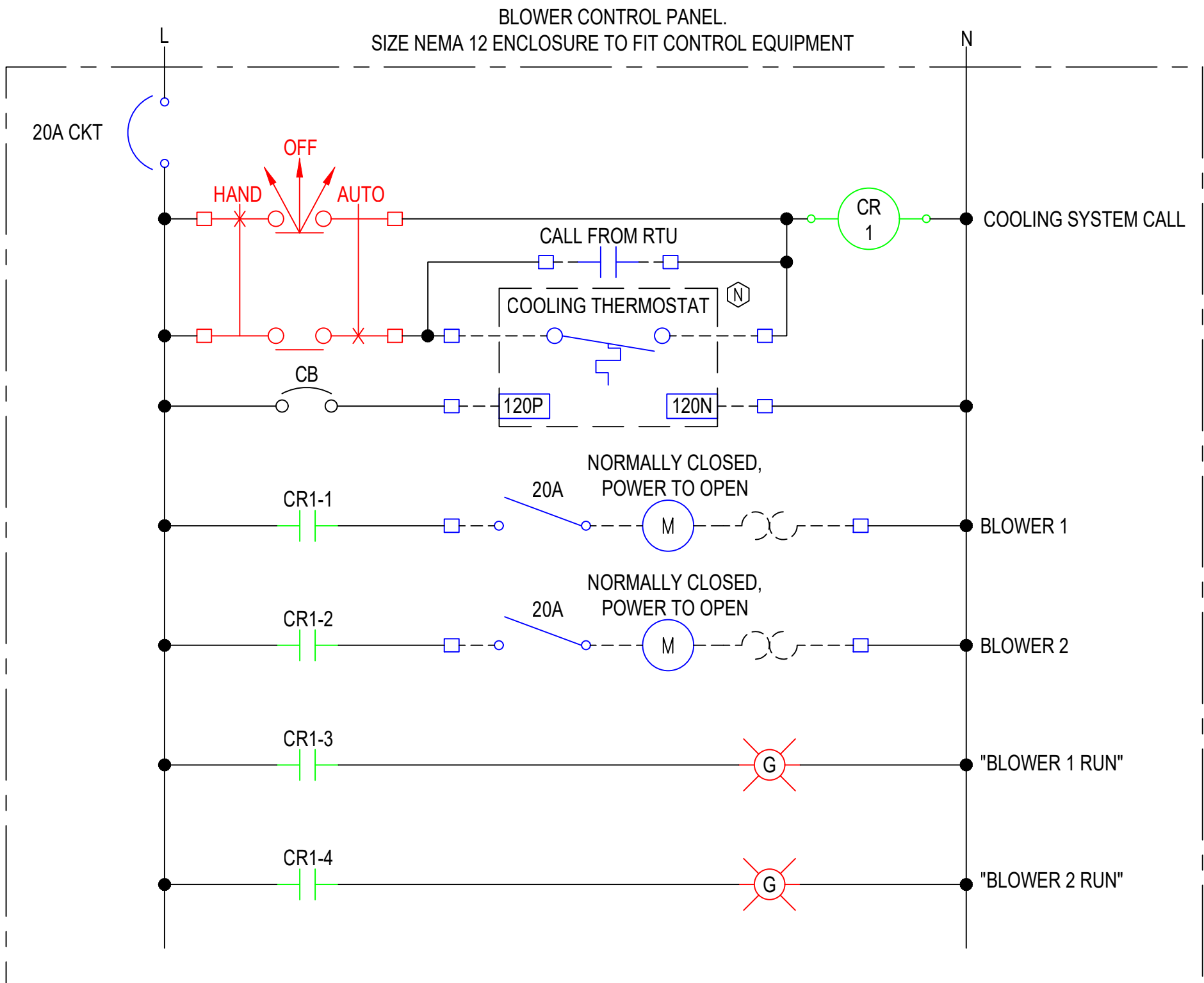
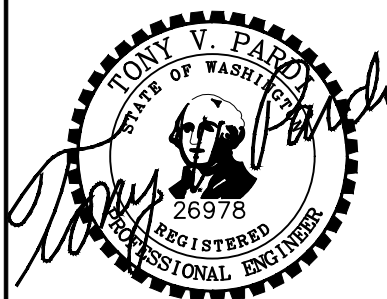


DIAGRAM 2: BLOWER CONTROL PANEL

NO SCALE



SIGNED: 03/02/2022



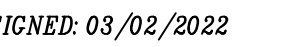
SIGNED: 03/02/2022

TACOMA WATER
BONNEY LAKE 950 ZONE TANK &
950/1010 ZONE BOOSTER PUMP STATION



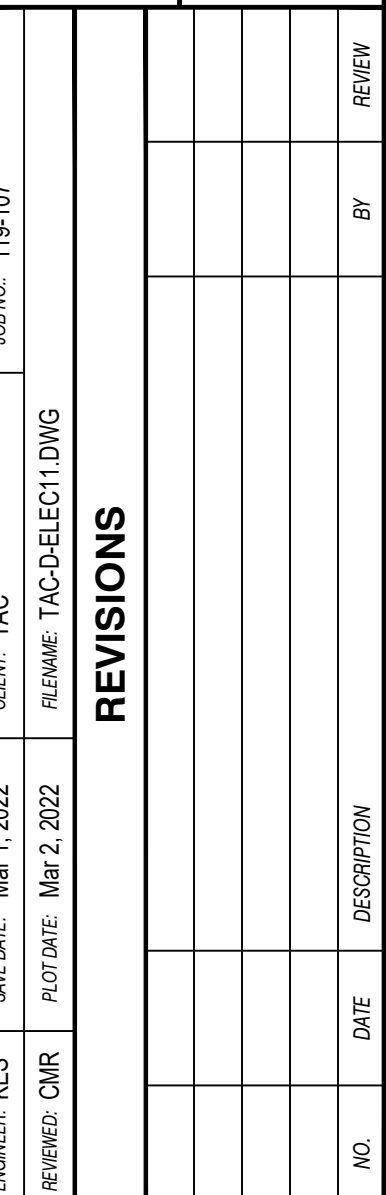
CONTROL LOGIC DIAGRAMS

ENGINEER: KES	DATE: Mar 1, 2022	CLIENT: TAC	JOB NO.: 119-107				
REVIEWED: CMR	PLOT DATE: Mar 2, 2022	FILENAME: TAC-D-ELEC08.DWG					
				REVISIONS			
NO.	DATE	DESCRIPTION	BY	REVIEW			

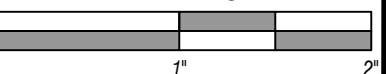


TACOMA WATER
BONNEY LAKE 950 ZONE TANK &
950/1010 ZONE BOOSTER PUMP STATION

ELECTRICAL DETAILS



SCALE: SHOWN



DRAWING IS FULL SCALE WHEN
BAR MEASURES 2"

FIG NO.: E06	SHEET NO.: 9
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POWER CONDUIT AND CONDUCTOR SCHEDULE				
CIRCUIT	SOURCE	DESTINATION	TRADE SIZE (QUANTITY) CONDUCTORS	NOTES
P1	UTILITY TRANSFORMER	CURRENT TRANSFORMER	(2) 3" (3) – #3/0, (1) – #3/0 N	PARALLEL CONDUCTORS
P2	CURRENT TRANSFORMER	UTILITY METER	1 1/4" (13) – #14	
P3	CURRENT TRANSFORMER	MAIN SERVICE DISCONNECT	(2) 2" (3) – #3/0, (1) – #3/0 N	PARALLEL CONDUCTORS
P4	MAIN SERVICE DISCONNECT	AUTOMATIC TRANSFER SWITCH, "ATS"	(2) 2" (3) – #3/0, (1) – #3 GRD	PARALLEL CONDUCTORS
P5	AUTOMATIC TRANSFER SWITCH, "ATS"	DISTRIBUTION PANEL, "DP"	(2) 2 1/2" (3) – #250 MCM, (1) – #2 GRD	PARALLEL CONDUCTORS
P6	DISTRIBUTION PANEL, "DP"	STANDBY GENERATOR	(2) 2 1/2" (3) – #250 MCM, (1) – #2 GRD	PARALLEL CONDUCTORS
P7	DISTRIBUTION PANEL, "DP"	PORTABLE GENERATOR DISCONNECT	(2) 2 1/2" (3) – #250 MCM, (1) – #2 GRD	PARALLEL CONDUCTORS
P8	PORTABLE GENERATOR DISCONNECT	PORTABLE GENERATOR TAP BOX	(2) 2 1/2" (3) – #250 MCM, (1) – #250 MCM N, (1) – #2 GRD	PARALLEL CONDUCTORS
P9	AUTOMATIC TRANSFER SWITCH, "ATS"	MOTOR CONTROL CENTER, "MCC"	(2) 2 1/2" (3) – #250 MCM, (1) – #2 GRD	PARALLEL CONDUCTORS
P10	MOTOR CONTROL CENTER, "MCC"	COMMUNICATIONS BUILDING HEATER	3/4"	
P11	MOTOR CONTROL CENTER, "MCC"	MINI POWER–ZONE, "L1"	3/4"	(3) – #10, (1) – #10 GRD
P12	MOTOR CONTROL CENTER, "MCC"	MINI POWER–ZONE, "L2"	3/4"	(3) – #8, (1) – #10 GRD
P13	MOTOR CONTROL CENTER, "MCC"	PUMP 1 MOTOR STARTER ENCLOSURE	3/4"	(3) – #8, (1) – #10 GRD
P14	PUMP 1 MOTOR STARTER ENCLOSURE	PUMP 1	1"	(3) – #12, (1) – #12 GRD
P15	MOTOR CONTROL CENTER, "MCC"	PUMP 2	1"	(3) – #12, (1) – #12 GRD
P16	MOTOR CONTROL CENTER, "MCC"	PUMP 3	1"	(3) – #10, (1) – #10 GRD
P17	MOTOR CONTROL CENTER, "MCC"	PUMP 4	1"	(3) – #10, (1) – #10 GRD
P18	MOTOR CONTROL CENTER, "MCC"	PUMP 5	2"	(3) – #3/0, (1) – #4 GRD
P19	MOTOR CONTROL CENTER, "MCC"	PUMP 6	2"	(3) – #3/0, (1) – #4 GRD
P20	MINI POWER–ZONE, "L1"	RESERVOIR POWER JUNCTION BOX	1"	(4) – #12, (1) – #12 GRD
P21	RESERVOIR POWER JUNCTION BOX	RESERVOIR ROOF POLE MOUNTED LIGHT	3/4"	(2) – #12, (1) – #12 GRD
P22	RESERVOIR POWER JUNCTION BOX	RESERVOIR ROOF RECEPTACLE	3/4"	(2) – #12, (1) – #12 GRD
P23	MINI POWER–ZONE, "L1"	LOWER LANDING LIGHT	1"	(2) – #12, (1) – #12 GRD
P24	MINI POWER–ZONE, "L1"	WATER QUALITY ANALYZER ENCLOSURE	1"	(2) – #12, (1) – #12 GRD
P25	RESERVOIR METER VAULT POWER JUNCTION BOX	METER VAULT SUMP PUMP DEDICATED RECEPTACLE	3/4"	(2) – #12, (1) – #12 GRD
P26	MINI POWER–ZONE, "L1"	RESERVOIR METER VAULT POWER JUNCTION BOX	1"	(2) – #12, (1) – #12 GRD
P27	MINI POWER–ZONE, "L1"	HANDHOLE FOR FUTURE POWER AND COMMUNICATIONS, "HH1"	2"	(1) NYLON PULL CORD
P28	MINI POWER–ZONE, "L1"	SITE LIGHT	1"	(2) – #12, (1) – #12 GRD
P29	MINI POWER–ZONE, "L2"	REMOTE I/O TELEMETRY PANEL, "REM–RTU"	3/4"	(2) – #12, (1) – #12 GRD
P30	MINI POWER–ZONE, "L2"	DEHUMIDIFIER 1 DEDICATED RECEPTACLE	3/4"	(2) – #12, (1) – #12 GRD
P31	MINI POWER–ZONE, "L2"	DEHUMIDIFIER 2 DEDICATED RECEPTACLE	3/4"	(2) – #12, (1) – #12 GRD
P32	BLOWER CONTROL PANEL	BLOWER 1	3/4"	(2) – #12, (1) – #12 GRD
P33	BLOWER CONTROL PANEL	BLOWER 2	3/4"	(2) – #12, (1) – #12 GRD
P34	MINI POWER–ZONE, "L2"	BPS SUMP PUMP 1 DEDICATED RECEPTACLE	3/4"	(2) – #12, (1) – #12 GRD
P35	MINI POWER–ZONE, "L2"	BPS SUMP PUMP 2 DEDICATED RECEPTACLE	3/4"	(2) – #12, (1) – #12 GRD
P36	MINI POWER–ZONE, "L2"	PORTABLE GENERATOR CONNECTION BOX	3/4"	(2) – #12, (1) – #12 GRD
P37	MINI POWER–ZONE, "L2"	BLOWER CONTROL PANEL	3/4"	(2) – #12, (1) – #12 GRD
P38	MINI POWER–ZONE, "L2"	BPS HEATER 1	3/4"	(2) – #10, (1) – #10 GRD
P39	MINI POWER–ZONE, "L2"	BPS HEATER 2	3/4"	(2) – #10, (1) – #10 GRD
P40	MINI POWER–ZONE, "L2"	PUMP 5 ACTUATOR	3/4"	(3) – #12, (1) – #12 GRD
P41	MINI POWER–ZONE, "L2"	PUMP 6 ACTUATOR	3/4"	(3) – #12, (1) – #12 GRD
P42	MINI POWER–ZONE, "L1"	TELEMETRY PANEL, "RTU"	3/4"	(2) – #12, (1) – #12 GRD
P43	MINI POWER–ZONE, "L1"	OUTDOOR HEAT PUMP	3/4"	(2) – #12, (1) – #10 GRD
P44	OUTDOOR HEAT PUMP	INDOOR HEAT PUMP	3/4"	(3) – #12, (1) – #12 GRD
P45	MINI POWER–ZONE, "L1"	STANDBY GENERATOR	3/4"	(4) – #12, (1) – #12 GRD
P46	MINI POWER–ZONE, "L1"	CATHODIC PROTECTION RECTIFIER	3/4"	(2) – #12, (1) – #12 GRD
P47	CATHODIC PROTECTION RECTIFIER	REFERENCE CELLS	SEE SPECS.	SEE SPECIFICATIONS
P48	CATHODIC PROTECTION RECTIFIER	PROTECTION ANODES	SEE SPECS.	SEE SPECIFICATIONS
P49	CATHODIC PROTECTION RECTIFIER	RESERVOIR	SEE SPECS.	SEE SPECIFICATIONS
P50	CATHODIC PROTECTION RECTIFIER	RESERVOIR	SEE SPECS.	SEE SPECIFICATIONS
P51	MINI POWER–ZONE, "L1"	VENTILATION CONTROL PANEL, "VCP"	3/4"	(2) – #12, (1) – #12 GRD
P52	VENTILATION CONTROL PANEL, "VCP"	INTAKE LOUVER ACTUATOR, "L101"	3/4"	(2) – #12, (1) – #12 GRD
P53	VENTILATION CONTROL PANEL, "VCP"	EXHAUST FAN, "EF"	3/4"	(2) – #12, (1) – #12 GRD
P54	MINI POWER–ZONE, "L2"	BPS VALVE VAULT JUNCTION BOX	1"	(2) – #12, (1) – #12 GRD
P55	BPS VALVE VAULT JUNCTION BOX	BPS VALVE VAULT SUMP PUMP DEDICATED RECEPTACLE	3/4"	(2) – #12, (1) – #12 GRD
P56	MINI POWER–ZONE, "L2"	BPS METER VAULT POWER JUNCTION BOX	1"	(2) – #12, (1) – #12 GRD
P57	BPS METER VAULT POWER JUNCTION BOX	BPS METER VAULT SUMP PUMP DEDICATED RECEPTACLE	3/4"	(2) – #12, (1) – #12 GRD
P58	HANDHOLE FOR FUTURE CELLULAR POWER, "HH–2"	HANDHOLE FOR FUTURE CELLULAR POWER, "HH–3"	4"	(1) NYLON PULL CORD
P59	CATHODIC PROTECTION RECTIFIER	BOOSTER PUMP STATION STUB–UP	2"	(1) NYLON PULL CORD
P60	DISTRIBUTION PANEL, "DP"	LOAD BANK TAP BOX	(2) 2 1/2" (3) – #250 MCM, (1) – #250 MCM N, (1) – #2 GRD	PARALLEL CONDUCTORS

NOTES:
1. GRAY BOXES SHOW CONDUITS TO BE PROVIDED BY OTHERS. ALL OTHER CONDUIT TO BE PROVIDED BY PUMP STATION SUPPLIER.

2. BOOSTER PUMP STATION SUPPLIER TO PROVIDE PRE-INSTALLED CONDUIT PENETRATIONS/SLEEVES IN BOOSTER PUMP STATION WALL FOR OTHERS TO USE FOR INSTALLATION OF CONDUITS ENTERING THE BOOSTER PUMP STATION FROM OUTSIDE THE BOOSTER PUMP STATION.

CONTROL CONDUIT AND CONDUCTOR SCHEDULE				
CIRCUIT	SOURCE	DESTINATION	TRADE SIZE (QUANTITY) CONDUCTORS	NOTES
C1	TELEMETRY PANEL, "RTU"	RESERVOIR METER VAULT JUNCTION BOX	1"	(4) – #14, (1) – #14 GRD
C2	RESERVOIR METER VAULT CONTROL AND INSTRUMENTATION JUNCTION BOX	RESERVOIR METER VAULT INTRUSION SWITCH	3/4"	(2) – #14, (1) – #14 GRD
C3	RESERVOIR METER VAULT CONTROL AND INSTRUMENTATION JUNCTION BOX	OPERATOR IN TROUBLE PUSHBUTTON	3/4"	(2) – #14, (1) – #14 GRD
C4	TELEMETRY PANEL, "RTU"	RESERVOIR CONTROL AND INSTRUMENTATION JUNCTION BOX	1"	(6) – #14, (1) – #14 GRD
C5	RESERVOIR CONTROL AND INSTRUMENTATION JUNCTION BOX	RESERVOIR ROOF ACCESS HATCH INTRUSION SWITCH	3/4"	(2) – #14, (1) – #14 GRD
C6	RESERVOIR CONTROL AND INSTRUMENTATION JUNCTION BOX	RESERVOIR FLOAT SWITCH	1"	MANUFACTURER'S FLOAT CABLE
C7	RESERVOIR CONTROL AND INSTRUMENTATION JUNCTION BOX	RESERVOIR VENT INTRUSION SWITCH	3/4"	(2) – #14, (1) – #14 GRD
C8	TELEMETRY PANEL, "RTU"	LOWER LANDING JUNCTION BOX	1"	(8) – #14, (1) – #14 GRD
C9	LOWER LANDING JUNCTION BOX	LOWER LANDING ACCESS HATCH INTRUSION SWITCH	3/4"	(2) – #14, (1) – #14 GRD
C10	LOWER LANDING JUNCTION BOX	VANDAL SHIELD INTRUSION SWITCH	3/4"	(2) – #14, (1) – #14 GRD
C11	LOWER LANDING JUNCTION BOX	LOWER LANDING MOTION DETECTOR	3/4"	(4) – #14, (1) – #14 GRD
C12	TELEMETRY PANEL, "RTU"	RESERVOIR SECURITY JUNCTION BOX	1"	(4) – #14, (1) – #14 GRD
C13	RESERVOIR SECURITY JUNCTION BOX	ROOF MOTION DETECTOR	3/4"	(4) – #14, (1) – #14 GRD
C14	REMOTE I/O TELEMETRY PANEL, "REM–RTU"	BPS SMOKE DETECTOR	3/4"	(4) – #14, (1) – #14 GRD
C15	REMOTE I/O TELEMETRY PANEL, "REM–RTU"	BPS OPERATOR IN TROUBLE PUSHBUTTON	3/4"	(2) – #14, (1) – #14 GRD
C16	BPS HEATER 1 HEATING THERMOSTAT	BPS HEATER 1	3/4"	(2) – #14, (1) – #14 GRD
C17	BPS HEATER 2 HEATING THERMOSTAT	BPS HEATER 2	3/4"	(2) – #14, (1) – #14 GRD
C18	REMOTE I/O TELEMETRY PANEL, "REM–RTU"	BPS PRESSURE RELIEF AND SUSTAINING VALVE LIMIT SWITCH	3/4"	(2) – #14, (1) – #14 GRD
C19	REMOTE I/O TELEMETRY PANEL, "REM–RTU"	BPS PRESSURE RELIEF VALVE LIMIT SWITCH AND SOLENOID	3/4"	(4) – #14, (1) – #14 GRD
C20	REMOTE I/O TELEMETRY PANEL, "REM–RTU"	BPS ACCESS HATCH 1 INTRUSION SWITCH	3/4"	(2) – #14, (1) – #14 GRD
C21	REMOTE I/O TELEMETRY PANEL, "REM–RTU"	BPS ACCESS HATCH 2 INTRUSION SWITCH	3/4"	(2) – #14, (1) – #14 GRD
C22	REMOTE I/O TELEMETRY PANEL, "REM–RTU"	BLOWER CONTROL PANEL	3/4"	(2) – #14, (1) – #14 GRD
C23	BPS COOLING THERMOSTAT	BLOWER CONTROL PANEL	3/4"	(4) – #14, (1) – #14 GRD
C24	REMOTE I/O TELEMETRY PANEL, "REM–RTU"	BPS FLOOD SWITCH	3/4"	(2) – #14, (1) – #14 GRD
C25	AUTOMATIC TRANSFER SWITCH, "ATS"	STANDBY GENERATOR	3/4"	(6) – #14, (1) – #14 GRD
C26	TELEMETRY PANEL, "RTU"	COMMUNICATIONS BUILDING INTRUSION SWITCH	3/4"	(2) – #14, (1) – #14 GRD
C27	TELEMETRY PANEL, "RTU"	COMMUNICATIONS BUILDING SMOKE DETECTOR	3/4"	(4) – #14, (1) – #14 GRD
C28	BUILDING HEATING THERMOSTAT	COMMUNICATIONS BUILDING HEATER	3/4"	(2) – #14, (1) – #14 GRD
C29	COMMUNICATIONS BUILDING COOLING THERMOSTAT	VENTILATION CONTROL PANEL, "VCP"	3/4"	(4) – #14, (1) – #14 GRD
C30	REMOTE I/O TELEMETRY PANEL, "REM–RTU"	BPS VALVE VAULT JUNCTION BOX	1"	(6) – #14, (1) – #14 GRD
C31	BPS VALVE VAULT JUNCTION BOX	BPS VALVE VAULT INTRUSION SWITCH	3/4"	(2) – #14, (1) – #14 GRD
C32	BPS VALVE VAULT JUNCTION BOX	BPS VALVE VAULT CHECK VALVE LIMIT SWITCH	3/4"	(2) – #14, (1) – #14 GRD
C33	BPS VALVE VAULT JUNCTION BOX	BPS VALVE VAULT OPERATOR IN TROUBLE PUSHBUTTON	3/4"	(2) – #14, (1) – #14 GRD
C34	REMOTE I/O TELEMETRY PANEL, "REM–RTU"	BPS METER VAULT CONTROL AND INSTRUMENTATION JUNCTION BOX	1"	(4) – #14, (1) – #14 GRD
C35	BPS METER VAULT CONTROL AND INSTRUMENTATION JUNCTION BOX	BPS METER VAULT INTRUSION SWITCH	3/4"	(2) – #14, (1) – #14 GRD
C36	BPS METER VAULT CONTROL AND INSTRUMENTATION JUNCTION BOX	BPS METER VAULT OPERATOR IN TROUBLE PUSHBUTTON	3/4"	(2) – #14, (1) – #14 GRD

INSTRUMENTATION CONDUIT AND CONDUCTOR SCHEDULE				
CIRCUIT	SOURCE	DESTINATION	TRADE SIZE (QUANTITY) CONDUCTORS	NOTES
J1	TELEMETRY PANEL, "RTU"	RESERVOIR METER VAULT JUNCTION BOX	2"	(1) 2–CONDUCTOR SHIELDED CABLE, MANUFACTURER'S FLOW METER CABLE
J2	RESERVOIR METER VAULT CONTROL AND INSTRUMENTATION JUNCTION BOX	RESERVOIR METER VAULT PRESSURE TRANSMITTER	3/4"	(1) 2–CONDUCTOR SHIELDED CABLE
J3	RESERVOIR METER VAULT CONTROL AND INSTRUMENTATION JUNCTION BOX	RESERVOIR METER VAULT FLOW METER	1 1/2"	MANUFACTURER'S FLOW METER CABLE
J4	TELEMETRY PANEL, "RTU"	RESERVOIR CONTROL AND INSTRUMENTATION JUNCTION BOX	1"	(1) 2–CONDUCTOR SHIELDED CABLE
J5	RESERVOIR CONTROL AND INSTRUMENTATION JUNCTION BOX	RESERVOIR LEVEL TRANSDUCER	1"	MANUFACTURER'S CABLE
J6	TELEMETRY PANEL, "RTU"	LOWER LANDING JUNCTION BOX	2"	(1) NYLON PULL CORD
J7	LOWER LANDING JUNCTION BOX	LOWER LANDING VIDEO CAMERA	2"	(1) NYLON PULL CORD
J8	RESERVOIR SECURITY JUNCTION BOX	UPPER LANDING VIDEO CAMERA	2"	(1) NYLON PULL CORD
J9	TELEMETRY PANEL, "RTU"	RESERVOIR SECURITY JUNCTION BOX	2"	(1) NYLON PULL CORD
J10	TELEMETRY PANEL, "RTU"	WATER QUALITY ANALYZER ENCLOSURE	1"	(2) 2–CONDUCTOR SHIELDED CABLES, (4) – #14, (1) #14 GRD
J11	TELEMETRY PANEL, "RTU"	HANDHOLE FOR FUTURE POWER AND COMMUNICATIONS, "HH1"	2"	(1) NYLON PULL CORD
J12	TELEMETRY PANEL, "RTU"	REMOTE I/O TELEMETRY PANEL, "REM–RTU"	1 1/2"	(1) FIBER OPTIC CABLE
J13	TELEMETRY PANEL, "RTU"	MOTOR CONTROL CENTER, "MCC"	2 1/2"	(6) CAT 5E ETHERNET CABLES, (2) – #14, (1) – #14 GRD
J14	TELEMETRY PANEL, "RTU"	PUMP 1 MOTOR STARTER ENCLOSURE	3/4"	(1) CAT 5E ETHERNET CABLE, (2) – #14, (1) – #14 GRD
J15	REMOTE I/O TELEMETRY PANEL, "REM–RTU"	PRESSURE TRANSMITTERS JUNCTION BOX	1 1/4"	(3) 2–CONDUCTOR SHIELDED CABLES
J16	COMMUNICATIONS RACKS	VAULT FOR TRANSITION TO RACEWAY	4"	(1) NYLON PULL CORD
J17	TELEMETRY PANEL, "RTU"	AUTOMATIC TRANSFER SWITCH, "ATS"	3/4"	(1) CAT 5E ETHERNET CABLE, (6) – #14, (1) – #14 GRD
J18	TELEMETRY PANEL, "RTU"	STANDBY GENERATOR	3/4"	(1) CAT 5E ETHERNET CABLE, (8) – #14, (1) – #14 GRD
J19	REMOTE I/O TELEMETRY PANEL, "REM–RTU"	BPS METER VAULT CONTROL AND INSTRUMENTATION JUNCTION BOX	1 1/2"	MANUFACTURER'S FLOW METER CABLE
J20	BPS METER VAULT CONTROL AND INSTRUMENTATION JUNCTION BOX	BPS METER VAULT FLOW METER	1 1/2"	MANUFACTURER'S FLOW METER CABLE
J21	REMOTE I/O TELEMETRY PANEL, "REM–RTU"	PUMP 5 ACTUATOR	3/4"	(1) CAT 5E ETHERNET CABLE
J22	REMOTE I/O TELEMETRY PANEL, "REM–RTU"	PUMP 6 ACTUATOR	3/4"	(1) CAT 5E ETHERNET CABLE
J23	HANDHOLE FOR FUTURE CELLULAR, "HH–4"	HANDHOLE FOR FUTURE CELLULAR, "HH–5"	4"	(1) NYLON PULL CORD
J24	COMMUNICATION RACKS	HANDHOLE FOR FUTURE CELLULAR, "HH–4"	4"	(1) NYLON PULL CORD
J25	COMMUNICATION RACKS	SITE LIGHT POLE	4"	(1) NYLON PULL CORD



TONY J. PARKER
STATE OF WASHINGTON
REGISTERED
PROFESSIONAL ENGINEER
25978

TP

SIGNED: 03/02/2022

CHRISTOPHER MICHAEL BOWEN
STATE OF WASHINGTON
REGISTERED
PROFESSIONAL ENGINEER
45317

MB

SIGNED: 03/02/2022

TACOMA WATER

BONNEY LAKE 950 ZONE TANK & 950/1010 ZONE BOOSTER PUMP STATION

CONDUIT AND CONDUCTOR SCHEDULES

ENGINEER: KES
REVIEWED: CMR

DATE: Mar 1, 2022
PLOT DATE: Mar 2, 2022

LOG NO.: 119-107
CLIENT: TAC
FILENAME: TAC-D-ELEC13.DWG

REVISIONS

NO.	DATE	DESCRIPTION	BY	REVIEW

SCALE: SHOWN

0"1"2"

DRAWING IS FULL SCALE WHEN BAR MEASURES 2"

DWG NO.: E08
SHEET NO.: 11

APPENDIX A

Signature Page
Bid Proposal Sheet
Record of Prior Contracts
Substitution Request Form

SIGNATURE PAGE

CITY OF TACOMA TACOMA WATER

All submittals must be in ink or typewritten, executed by a duly authorized officer or representative of the bidding/proposing entity, and received and time stamped as directed in the **Request for Bids page near the beginning of the specification**. If the bidder/proposer is a subsidiary or doing business on behalf of another entity, so state, and provide the firm name under which business is hereby transacted.

REQUEST FOR BIDS SPECIFICATION NO. TW22-0112F Bonney Lake 950/1010 Booster Pump Station

The undersigned bidder/proposer hereby agrees to execute the proposed contract and furnish all materials, labor, tools, equipment and all other facilities and services in accordance with these specifications.

The bidder/proposer agrees, by submitting a bid/proposal under these specifications, that in the event any litigation should arise concerning the submission of bids/proposals or the award of contract under this specification, Request for Bids, Request for Proposals or Request for Qualifications, the venue of such action or litigation shall be in the Superior Court of the State of Washington, in and for the County of Pierce.

Non-Collusion Declaration

The undersigned bidder/proposer hereby certifies under penalty of perjury that this bid/proposal is genuine and not a sham or collusive bid/proposal, or made in the interests or on behalf of any person or entity not herein named; and that said bidder/proposer has not directly or indirectly induced or solicited any contractor or supplier on the above work to put in a sham bid/proposal or any person or entity to refrain from submitting a bid/proposal; and that said bidder/proposer has not, in any manner, sought by collusion to secure to itself an advantage over any other contractor(s) or person(s).

Bidder/Proposer's Registered Name

Signature of Person Authorized to Enter Date
into Contracts for Bidder/Proposer

Address

Printed Name and Title

City, State, Zip

(Area Code) Telephone Number / Fax Number

Authorized Signatory E-Mail Address

State Business License Number
in WA, also known as UBI (Unified Business Identifier) Number

E.I.No. / Federal Social Security Number Used on Quarterly
Federal Tax Return, U.S. Treasury Dept. Form 941

State Contractor's License Number
(See Ch. 18.27, R.C.W.)

E-Mail Address for Communications

Addendum acknowledgement #1_____ #2_____ #3_____ #4_____ #5_____

THIS PAGE MUST BE SIGNED AND RETURNED WITH SUBMITTAL.

Tacoma Water
BID PROPOSAL SHEET

TW22-0112F Bonney Lake 950/1010 Booster Pump Station

Item	Description	Units	Quantity	Unit Price	Total Price
1	Packaged Booster Pump Station	LS	1	\$ _____ _____	\$ _____ _____
2	Storage of Packaged Booster Pump Station	DAY	56	\$ _____ _____	\$ _____ _____
3	Automatic Control (S&B Inc.) Package	LS	1	\$ _____ _____	\$ _____ _____
4	Testing, Startup, and Training (\$5,000 min.)	LS	1	\$ _____ _____	\$ _____ _____
SUBTOTAL (Items 1-4)					\$ _____ _____
WSST @ 9.4%					\$ _____ _____
TOTAL AMOUNT BID					\$ _____ _____

RECORD OF PRIOR CONTRACTS

NAME _____ ADDRESS _____

Type of Work _____ **Specification No.** _____

[illegible][illegible]

TACOMA WATER SUBSTITUTION REQUEST FORM

***This request shall be submitted to the engineer listed below no later than 3:00 p.m., PST, Tuesday, April 26, 2022 per 1.33.23 Shop Drawings, Product Data, and Samples
Substitution requests not received by the engineer will not be considered.***

ATTN: Carol Powers P.E.

Date: _____

PROJECT: TW22-0112F Bonney Lake 950/1010 Booster Pump Station Transmittal No. _____
(Specification/Name/Contract No., if applicable)

We hereby submit for consideration, the following product instead of the specified item for the above project:

Specification Section: _____
Specified Item: _____
Proposed Substitution: _____

NOTES: Attach complete technical data, including laboratory tests and samples as applicable.

Provide a detailed comparison of the significant qualities (size, weight, durability, performance and similar characteristics, including visual effect, where applicable) for the proposed substitution in comparison with the original requirements.

List completely, installation changes, changes to drawings, and specifications required by the proposal.

FILL IN BLANKS BELOW:

- A. Does substitution require change in drawing dimensions? ☐ Yes ☐ No
If yes, provide detail: _____
- B. Will undersigned pay for resulting building design changes including engineering/detailing costs? ☐ Yes ☐ No
- C. What effect does substitution have on other trades?

- D. Difference between proposed substitution and specified item?

- E. Manufacturer's guarantees of proposed and specified items are? ☐ Same ☐ Different*
*Explain differences on attachment(s).
- F. Are maintenance/service parts locally (within 50 miles) available for proposed substitution? ☐ Yes ☐ No
- G. Will the proposed substitution have any effect on compliance with applicable codes? ☐ Yes ☐ No
If yes, explain: _____
- H. Name, address, and current phone number of the Project Lead for one (1) similar project where the proposed product was used, along with the Project name and date of installation:

- I. Contract completion date is? _____ ☐ Same ☐ Different*
*Explain differences on attachment(s).

TACOMA POWER / GENERATION SUBSTITUTION REQUEST FORM

***This request shall be submitted to the engineer listed below no later than 3:00 p.m., PST, Tuesday, April 26, 2022 per 1.33.23 Shop Drawings, Product Data, and Samples
Substitution requests not received by the engineer will not be considered.***

Undersigned attests function and quality equivalent or superior to specified item and waives their rights to additional payment and time which may subsequently be necessitated by failure of the substitution to perform adequately, and for the required work to make corrections thereof.

SUBMITTED BY:

Name

Firm

Address

City, State, Zip

Phone No.

Signature

Date

FOR USE BY TACOMA WATER

☐ Accepted

☐ Accepted as Noted

☐ Not Accepted

☐ Received Too Late

By: Carol Powers P.E.

(Project Lead/Manager)

Signature: _____

Date: _____

REMARKS:

APPENDIX B

Sample Contract
Sample Performance Bond
Insurance Requirements

CONTRACT

Resolution No. [#####]

Contract No. [#####]

This Contract is made and entered into effective as of [Month], [Day], [Year] ("Effective Date") by and between the City of Tacoma, a Municipal Corporation of the State of Washington ("City"), and [supplier name as it appears in Ariba, including dbas or trade names] ("Contractor"). [Contract date should match date of award letter and month should be formally spelled out]

That in consideration of the mutual promises and obligations hereinafter set forth the Parties hereto agree as follows:

- I. Contractor shall fully execute and diligently and completely perform all work and provide all services and deliverables described herein and in the items listed below each of which are fully incorporated herein and which collectively are referred to as "Contract Documents":

-
1. Specification No. [Spec Number] [Spec Title] together with all authorized addenda.
 2. Contractor's submittal [or specifically described portions thereof] dated [Enter Submittal Date] submitted in response to Specification No. [Spec Number] [Spec Title].
 3. Describe with specific detail and list separately any other documents that will make up the contract (fee schedule, work schedule, authorized personnel, etc.) or any other additional items mutually intended to be binding upon the parties.
-

[Delete this highlighted sentence, paragraph III and sub-bullets #1 and #2 if there are no additional attachments to the contract (attachments would be things other than a spec, contract, or bonds)]

- II. If federal funds will be used to fund, pay or reimburse all or a portion of the services provided under the Contract, the terms and conditions set forth at this Appendix A are incorporated into and made part of this Contract and CONTRACTOR will comply with all applicable provisions of Appendix A and with all applicable federal laws, regulations, executive orders, policies, procedures, and directives in the performance of this Contract.

If CONTRACTOR's receipt of federal funds under this Contract is as a sub-recipient, a fully completed Appendix B, "Sub-recipient Information and Requirements" is incorporated into and made part of this Contract.

- III. In the event of a conflict or inconsistency between the terms and conditions contained in this document entitled Contract and any terms and conditions contained the above referenced Contract Documents the following order of precedence applies with the first listed item being the most controlling and the last listed item the least controlling:

1. Contract, inclusive of Appendices A and B.
2. List remaining Contract Documents in applicable controlling order. [If the only contract documents are the specification and submittal and no exceptions are taken in the submittal, this section should be deleted]

- IV. The Contract terminates on xxxxx, and may be renewed for xxxxxxxx [Complete as needed and as stated in the specification]

- V. The total price to be paid by City for Contractor's full and complete performance hereunder, including during any authorized renewal terms, may not exceed: \$[Dollar Amount], plus any applicable taxes.

- VI. Contractor agrees to accept as full payment hereunder the amounts specified herein and in Contract Documents, and the City agrees to make payments at the times and in the manner and upon the terms and conditions specified. Except as may be otherwise provided herein or in Contract Documents Contractor shall provide and bear the expense of all equipment, work and labor of any sort whatsoever that may be required for the transfer of materials and for constructing and completing the work and providing the services and deliverables required by this Contract.

- VII. The City's preferred method of payment is by ePayables (Payment Plus), followed by credit card (aka procurement card), then Electronic Funds Transfer (EFT) by Automated Clearing House (ACH), then check or other cash equivalent. CONTRACTOR may be required to have the capability of accepting the City's ePayables or credit card methods of payment. The City of Tacoma will not accept price changes or pay additional fees when ePayables (Payment Plus) or credit card is used. The City, in its sole discretion, will determine the method of payment for this Contract.
- VIII. Failure by City to identify a deficiency in the insurance documentation provided by Contractor or failure of City to demand verification of coverage or compliance by Contractor with the insurance requirements contained in the Contract Documents shall not be construed as a waiver of Contractor's obligation to maintain such insurance.
- IX. Contractor and for its heirs, executors, administrators, successors, and assigns, does hereby agree to the full performance of all the requirements contained herein and in Contract Documents.
- It is further provided that no liability shall attach to City by reason of entering into this Contract, except as expressly provided herein.

IN WITNESS WHEREOF, the Parties hereto have accepted and executed this Contract, as of the Effective Date stated above, which shall be Effective Date for bonding purposes as applicable.

CITY OF TACOMA:

Signature:

Name:

Title:

CONTRACTOR:

Signature:

Name:

Title:

(City of Tacoma use only - blank lines are intentional)

Director of Finance: _____

Deputy/City Attorney (approved as to form): _____

Approved By: _____

Approved By: _____

Approved By: _____

Approved By: _____

Approved By: _____

Approved By: _____

APPENDIX A



PERFORMANCE BOND TO THE CITY OF TACOMA

Resolution No.
Bond No.

That we, the undersigned,

as principal, and

as a surety, are jointly and severally held and firmly bound to the CITY OF TACOMA, in the penal sum of

\$ _____, for the payment whereof Contractor and Surety bind themselves,

their executors, administrators, legal representatives, successors and assigns, jointly and severally, firmly by these presents.

This obligation is entered into in pursuance of the statutes of the State of Washington, the Ordinances of the City of Tacoma.

WHEREAS, under and pursuant to the City Charter and general ordinances of the City of Tacoma, the said City has or is about to enter with the above bounden principal, a contract, providing for

Specification No. _____

Specification Title: _____

Contract No. _____

(which contract is referenced to herein and is made a part hereof as though attached hereto), and

WHEREAS, the said principal has accepted, the said contract, and undertake to perform the work therein provided for in the manner and within the time set forth.

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

If the City shall commence suit and obtain judgment against the Surety for recovery hereunder, then the Surety, in addition to such judgement, shall pay all costs and attorney's fees incurred by the City in enforcement of its rights hereunder. Venue for any action arising out of in connection with this bond shall be in Pierce County, Washington.

Surety companies executing bonds must be authorized to transact 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. Department of the Treasury.

One original bond shall be executed, and signed by the parties' duly authorized officers. This bond will only be accepted if it is accompanied by a fully executed power of attorney for the office executing on behalf of the surety.

Principal: Enter Vendor Legal Name

By: _____

Surety:

By: _____

Agent's Name: _____

Agent's Address: _____



CITY OF TACOMA

INSURANCE REQUIREMENTS FOR CONTRACTS

The Contractor (Contractor) shall maintain at least the minimum insurance set forth below. By requiring such minimum insurance, the City of Tacoma shall not be deemed or construed to have assessed the risk that may be applicable to Contractor under this Contract. Contractor shall assess its own risks and, if it deems appropriate and/or prudent, maintain greater limits and/or broader coverage.

1. GENERAL REQUIREMENTS

The following General Requirements apply to Contractor and to Subcontractor(s) of every tier performing services and/or activities pursuant to the terms of this Contract. Contractor acknowledges and agrees to the following insurance requirements applicable to Contractor and Contractor's Subcontractor(s):

- 1.1. City of Tacoma reserves the right to approve or reject the insurance provided based upon the insurer, terms and coverage, the Certificate of Insurance, and/or endorsements.
- 1.2. Contractor shall not begin work under the Contract until the required insurance has been obtained and approved by City of Tacoma.
- 1.3. Contractor shall keep this insurance in force during the entire term of the Contract and for Thirty (30) calendar days after completion of all work required by the Contract, unless otherwise provided herein.
- 1.4. Insurance policies required under this Contract that name "City of Tacoma" as Additional Insured shall:
 - 1.4.1. Be considered primary and non-contributory for all claims.
 - 1.4.2. Contain a "Separation of Insured provision and a "Waiver of Subrogation" clause in favor of City of Tacoma.
- 1.5. Section 1.4 above does not apply to contracts for purchasing supplies only.
- 1.6. Verification of coverage shall include:
 - 1.6.1. An ACORD certificate or equivalent.
 - 1.6.2. Copies of all endorsements naming the City of Tacoma as additional insured and showing the policy number.
 - 1.6.3. A notation of coverage enhancements on the Certificate of Insurance shall not satisfy these requirements – actual endorsements must be submitted.
- 1.7. Liability insurance policies, with the exception of Professional Liability and Workers' Compensation, shall name the City of Tacoma and its officers, elected officials, employees, agents, and authorized volunteers as additional insured.
 - 1.7.1. No specific person or department should be identified as the additional insured.
 - 1.7.2. All references on certificates of insurance and endorsements shall be listed as "City of Tacoma".



CITY OF TACOMA

INSURANCE REQUIREMENTS FOR CONTRACTS

- 1.7.3. The City of Tacoma shall be additional insured for both ongoing and completed operations using Insurance Services Office (ISO) form CG 20 10 04 13 and CG 20 37 04 13 or the equivalent 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 describes limits lower than those maintained by the Contractor.
- 1.8. Contractor shall provide a Certificate of Insurance for each policy of insurance meeting the requirements set forth herein when Contractor provides the signed Contract for the work to City of Tacoma. Contractor shall provide copies of any applicable Additional Insured, Waiver of Subrogation, and Primary and Non-contributory endorsements. Contract or Permit number and the City Department must be shown on the Certificate of Insurance.
- 1.9. Insurance limits shown below may be written with an excess policy that follows the form of an underlying primary liability policy or an excess policy providing the required limit.
- 1.10. Liability insurance policies shall be written on an "occurrence" form, except for Professional Liability/Errors and Omissions, Pollution Liability, and Cyber/Privacy and Security
- 1.11. If coverage is approved and purchased on a "Claims-Made" basis, Contractor warrants continuation of coverage, either through policy renewals or by the purchase of an extended reporting period endorsement as set forth below.
- 1.12. The insurance must be written by companies licensed or authorized in the State of Washington pursuant to RCW 48 with an (A-) VII or higher in the A.M. Best's Key Rating Guide www.ambest.com.
- 1.13. Contractor shall provide City of Tacoma notice of any cancellation or non-renewal of this required insurance within Thirty (30) calendar days.
- 1.14. Contractor shall not allow any insurance to be cancelled or lapse during any term of this Contract, otherwise it shall constitute a material breach of the Contract, upon which City of Tacoma may, after giving Five (5) business day notice to 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 City of Tacoma by Contractor upon demand, or at the sole discretion of City of Tacoma, offset against funds due Contractor from City of Tacoma.
- 1.15. Contractor shall be responsible for the payment of all premiums, deductibles and self-insured retentions, and shall indemnify and hold the City of Tacoma harmless to the extent such a deductible or self-insured retained limit may apply to the City of Tacoma as an additional insured. Any deductible or self-insured retained limits in excess of Twenty Five Thousand Dollars (\$25,000) must be disclosed and approved by City of Tacoma Risk Manager and shown on the Certificate of Insurance.



CITY OF TACOMA

INSURANCE REQUIREMENTS FOR CONTRACTS

- 1.16. City of Tacoma reserves the right to review insurance requirements during any term of the Contract and to require that Contractor make reasonable adjustments when the scope of services has changed.
- 1.17. 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 by City of Tacoma to Contractor.
- 1.18. Insurance coverages specified in this Contract are not intended and will not be interpreted to limit the responsibility or liability of Contractor or Subcontractor(s).
- 1.19. Failure by City of Tacoma to identify a deficiency in the insurance documentation provided by Contractor or failure of City of Tacoma to demand verification of coverage or compliance by Contractor with these insurance requirements shall not be construed as a waiver of Contractor's obligation to maintain such insurance.
- 1.20. If Contractor is a State of Washington or local government and is self-insured for any of the above insurance requirements, a certification of self-insurance shall be attached hereto and be incorporated by reference and shall constitute compliance with this Section.

2. CONTRACTOR

As used herein, "Contractor" shall be the Supplier(s) entering a Contract with City of Tacoma, whether designated as a Supplier, Contractor, Vendor, Proposer, Bidder, Respondent, Seller, Merchant, Service Provider, or otherwise.

3. SUBCONTRACTORS

It is Contractor's responsibility to ensure that each subcontractor obtain and maintain adequate liability insurance coverage. Contractor shall provide evidence of such insurance upon City of Tacoma's request.

4. REQUIRED INSURANCE AND LIMITS

The insurance policies shall provide the minimum coverages and limits set forth below. Providing coverage in these stated minimum limits shall not be construed to relieve Contractor from liability in excess of such limits.

4.1 Commercial General Liability Insurance

Contractor shall maintain Commercial General Liability Insurance policy with limits not less than One Million Dollars (\$1,000,000) each occurrence and Two Million Dollars (\$2,000,000) annual aggregate. The Commercial General Liability Insurance policy shall be written on an Insurance Services Office form CG 00 01 04 13 or its equivalent. Products and Completed Operations shall be maintained for a period of three years following Substantial Completion of the Work related to performing construction services.

This policy shall include product liability especially when a Contract solely is for purchasing supplies. The Commercial General Liability policy shall be endorsed to include:

- 4.2 A per project aggregate policy limit, using ISO form CG 25 03 05 09 or an equivalent endorsement.



CITY OF TACOMA

INSURANCE REQUIREMENTS FOR CONTRACTS

4.3 Commercial (Business) Automobile Liability Insurance

Contractor shall maintain Commercial Automobile Liability policy with limits not less than One Million Dollars (\$1,000,000) each accident for bodily injury and property damage and bodily injury and property damage coverage for owned (if any), non-owned, hired, or leased vehicles. Commercial Automobile Liability Insurance shall be written using ISO form CA 00 01 or equivalent. Contractor must also maintain an MCS 90 endorsement or equivalent and a CA 99 48 endorsement or equivalent if "Pollutants" are to be transported.

4.4 Workers' Compensation

Contractor shall comply with Workers' Compensation coverage as required by the Industrial Insurance laws of the State of Washington, as well as any other similar coverage required for this work by applicable federal laws of other states. The Contractor must comply with their domicile State Industrial Insurance laws if it is outside the State of Washington.

4.5 Employers' Liability Insurance

Contractor shall maintain Employers' Liability coverage with limits not less than One Million Dollars (\$1,000,000) each employee, One Million Dollars (\$1,000,000) each accident, and One Million Dollars (\$1,000,000) policy limit.

4.6 Professional Liability Insurance or Errors and Omissions

Contractor and/or its subcontractor shall maintain Professional Liability or Errors and Omissions with limits of One Million Dollars (\$1,000,000) per claim and Two Million Dollars (\$2,000,000) in the aggregate covering acts, errors and omissions arising out of the professional services under this Contract.

If the policy limit includes the payment of claims or defense costs, from the policy limit, the per claim limit shall be Two Million Dollars (\$2,000,000).

If the scope of such design-related professional services includes work related to pollution conditions, the Professional Liability policy shall include Pollution Liability coverage.

If provided on a "claims-made" basis, such coverage shall be maintained by policy renewals or an extended reporting period endorsement for not less than three years following the end of the Contract.

4.7 Excess or Umbrella Liability Insurance

Contractor shall provide Excess or Umbrella Liability Insurance with limits not less than Three Million Dollars (\$3,000,000) per occurrence and in the aggregate. This coverage shall apply, at a minimum, in excess of primary underlying Commercial General Liability, Employer's Liability, Pollution Liability, Marine General Liability, Protection and Indemnity, and Automobile Liability if required herein.

4.8 Builder's Risk Insurance

Contractor shall maintain during the term of the Contract and until final acceptance of the work by the City of Tacoma, a policy of Builder's Risk Insurance providing coverage for all-risk of physical injury to all structures to be constructed according to the Contract. City of Tacoma shall be included as a named insured (not named as additional insured) on the policy. Builder's Risk Insurance policy shall:

- 4.8.1 Have a deductible of no more than Five Thousand Dollars (\$5,000) for each occurrence, the payment of which will be the responsibility of Contractor. Any increased deductibles accepted by City of Tacoma will remain the responsibility of Contractor.



CITY OF TACOMA INSURANCE REQUIREMENTS FOR CONTRACTS

- 4.8.2 Be on an ISO Special Form Causes of Loss or equivalent and shall insure against the perils flood, earthquake, theft, vandalism, malicious mischief, and collapse.
- 4.8.3 Include coverage for temporary buildings, debris removal, and damage to materials in transit or stored off-site.
- 4.8.4 Be written in the amount of the completed value of the structures, with no coinsurance provisions exposure on the part of Contractor or City of Tacoma.
- 4.8.5 Contain a Waiver of Subrogation provision whereby each insured waives their subrogation rights to the extent the loss is covered by this insurance.
- 4.8.6 Grant permission to occupy, allowing the building or structure to be partially occupied prior to completion, without detrimental effect to the coverage provided.
- 4.8.7 Include coverage for the testing and startup of the building's operating systems.
- 4.8.8 Include coverage for City of Tacoma's loss of use or business interruption arising out of a covered loss which delays completion.
- 4.8.9 Include resultant damage coverage for loss due to faulty workmanship and defective material.

Contractor and City of Tacoma waive all rights against each other, their respective subcontractors, agents, and representatives for damages caused by fire or other perils to the extent covered by Builder's Risk Insurance or other property insurance applicable to the work. The policies shall provide such waivers by endorsement or otherwise.

4.9 Other Insurance

Other insurance may be deemed appropriate to cover risks and exposures related to the scope of work or changes to the scope of work required by City of Tacoma. The costs of such necessary and appropriate Insurance coverage shall be borne by Contractor.