

**TECHNICAL SPECIFICATIONS
FOR
LIPOA WASTEWATER PUMP STATION
KIHEI, MAUI, HAWAII 96761
MAUI COUNTY JOB NO: WW19-02**

PREPARED FOR:

**DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
WASTEWATER RECLAMATION DIVISION
COUNTY OF MAUI
2200 MAIN STREET, SUITE 610
WAILUKU, MAUI, HAWAII 96793**

PREPARED BY:

CIVIL ENGINEER:	Kennedy/Jenks Consultants
STRUCTURAL ENGINEER	Miyasato Kuniyoshi Engineers
ARCHITECT	Kennedy/Jenks Consultants
MECHANICAL ENGINEER	Kennedy/Jenks Consultants
ELECTRICAL ENGINEER	Morikawa & Associates, LLC.

September 2025



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SECTION 00020

INVITATION TO BID

LIPOA WASTEWATER PUMP STATION
COUNTY JOB NO. WW19-02
AT KIHEI, MAUI, HAWAII

Pursuant to Chapter 103-D, HRS, **ELECTRONIC** sealed bids for the following project: "**LIPOA WASTEWATER PUMP STATION, COUNTY JOB NO. WW-19-02**", will be received and recorded immediately via the Public Purchase System until **2:00 PM** Hawaii Standard Time, on **October 30, 2025**. Bids shall be submitted via the Public Purchase System, otherwise bids shall not be opened or considered. Also, bids received after the time fixed for opening will not be considered.

The work includes the furnishing of labor, materials, supplies and equipment required for:

- Demolition, grading, and construction of other site improvements,
- Construction of a submersible wastewater pump station,
- Construction of an odor control system,
- Construction of electrical building,
- Installation of an emergency generator and above-grade fuel storage tank,
- Connection to the influent sewer and to the effluent force main,
- Startup, commissioning, and testing services.

Contract Documents and proposal forms are available solely via Public Purchase, a web-based e-procurement system. Instruction to view and download the bid specification and plans for the procurement are included in the link below:

<http://www.mauicounty.gov/DocumentCenter/View/91025>

The registration site link is:

<https://www.publicpurchase.com/gems/register/vendor/register>

Bidders must be qualified in compliance with Section 103D-310 of the Hawaii Revised Statutes.

A non-mandatory pre-bid meeting will be conducted for the project. Interested parties are invited to join virtually via the Microsoft Teams meeting, which can be accessed at the following web address:

https://teams.microsoft.com/l/meetup-join/19%3ameeting_N2Q4NWQzNDAtZjc4ZS00ZGQ4LTgxMzUtYTUyMTVjYTM4ZTA3%40thread.v2/0?context=%7b%22Tid%22%3a%2234eeab25-8035-4064-b154-7b5fa295796f%22%2c%22Oid%22%3a%22d3112e4b-99d4-41c4-80a8-4f09fcafc84f%22%7d

Meeting ID: 240 816 777 683 2

Passcode: k36SH9CJ

Time: October 14, 2025 at 2:00 PM Hawaii Standard Time

Bidders are required to comply with newest procurement code, HRS, Chapter 103-D, any rules and regulations and policy directives issued with respect to Chapter 103-D and any amendments thereof.

Bidders must correctly prepare and submit the documents listed in Section 00300, Bid Proposal.



MARCY MARTIN
DIRECTOR OF FINANCE
COUNTY OF MAUI

SECTION 00100
INSTRUCTIONS TO BIDDERS

1.01 INSPECTION OF SITE

Bidders are strongly encouraged to inspect the site of the work to satisfy themselves by personal examination or by such other means as they may prefer, of the location of the proposed work, and of the actual conditions of and at the site of work. The Department of Environmental Management, Wastewater Reclamation Division will hold a non-mandatory pre-bid meeting and site inspection as described on Specification Section 00020 – Invitation to Bid.

If, during the course of his examination, a bidder finds facts or conditions which appear to him to be in conflict with the letter or spirit of the project manual, he may apply to the County, in writing, for additional information and explanation before submitting his bid.

Submission of a bid by the bidder shall constitute acknowledgment that, if awarded the contract, he has relied and is relying on his own examination of (1) the site of the work, (2) access to the site, and (3) all other data and matters requisite to the fulfillment of the work and on his own knowledge of existing facilities on and in the vicinity of the site of the work to be constructed under the contract.

The information provided by the County is not intended to be a substitute for, or a supplement to, the independent verification by the bidder to the extent such independent investigation of site conditions is deemed necessary or desirable by the bidder. Bidder acknowledges that he has not relied upon County furnished information regarding site conditions in preparing and submitting a bid hereunder.

1.02 EXAMINATION OF PROJECT MANUAL

Each bidder shall thoroughly examine and be familiar with those contract documents contained in the project manual. Submission of a bid shall constitute acknowledgment upon which the County may rely that the bidder has thoroughly examined and is familiar with the project manual. Bidder shall be responsible for verifying that each specification section listed in the table of contents of the project manual and each drawing shown on the index of the drawings, has been considered and included as a component of the bid. Failure or neglect of a bidder to examine any of the contract documents contained in the project manual shall in no way relieve him from any obligation with respect to his bid or to the contract. No claim for additional compensation will be allowed which is based upon a lack of knowledge of the work.

1.03 INTERPRETATION OF PROJECT MANUAL

Pursuant to the General Conditions Section **00710-2.10** of the Project Specifications, Bidders, prospective subcontractors, manufacturers, and suppliers may request interpretation of the project manual no less than **ten (10) calendar days** prior to the date of bid opening. Requests shall be directed **online via the Public Purchase Website**.

Requests to clarify the source of materials, equipment, suppliers, or any other such matter which does not modify, change, increase, or decrease the scope of work requires no action by the County other than a response to the bidder requesting the clarification. Requests for clarification of possibly ambiguous, conflicting or incomplete statements or designs; or any other such clarification which modifies, changes, or increases or decreases the scope of work, will require the issuance of an addendum by the County for the interpretation to become effective.

1.04 BID DOCUMENTS

A. BID FORMS

1. **GENERAL:** Bids shall be made on the blank bid forms prepared and provided by the Department of Finance. The bid form included herein is for information only and is not to be used for final bidding. Bids shall give the prices proposed, both in writing and in figures, shall give all other information requested, and shall be signed by the bidder or his authorized representative, with his address.
2. **BID PRICES:** Bid prices shall include everything necessary for the completion of the work, including but not limited to, providing the materials, equipment, tools, and other facilities, and the management, superintendence, labor, and services. Bid prices shall include federal, state, and local taxes.

In the event of a difference between a price quoted in words and a price quoted in figures for the same quotation, the words shall be the amount bid. In the event that the product of a unit price and an estimated quantity does not equal the extended amount quoted, the unit price shall govern, and the correct product of the unit price and the estimated quantity shall be deemed to be the amount bid. If the sum of two or more items in a bidding schedule does not equal the total amounts quoted, the individual item amounts shall govern and the correct total shall be deemed to be the amount bid.

3. **BIDDER'S SIGNATURE AND AUTHORITY:** If the bid is made by an individual, his name, signature, and post office address must be shown; if made by a firm or partnership, the name and post office

address of the firm or partnership, a list of the partners, and the signature of at least one of the general partners must be shown; if made by a corporation, the bid shall show the name of the state under the laws of which the corporation is chartered, the name and post office address of the corporation, and the title of the person who signs on behalf of the corporation. If the bid is made by the corporation, a certified copy of the bylaws or resolution of the Board of Directors of the corporation shall be furnished showing the authority of the officer signing the bid to execute contracts on behalf of the corporation. If the bid is made by a joint venture, the bid shall be signed by a representative of one of the joint venture firms. Additionally, the bid shall include a copy of the resolution or agreement empowering the representative to execute the bid and bind the joint venture.

4. **BID IRREGULARITIES:** Each bid and the information requested shall be enclosed in a sealed envelope and labeled as specified in the Invitation to Bid. Bidders are warned against making erasures or alterations of any kind, and bids which contain omissions, erasures, or irregularities of any kind may be rejected.

Bids, prices, or modifications to bids or prices shall not be submitted by telephone facsimile transmission, which will not be accepted.

5. **MODIFICATION OF BID:** Modification of a bid already received will be considered only if the modification is received prior to the time established for bid opening.

Any Bidder may modify his bid by written communications at any time, provided such communication is completely received by the Bid Receiver prior to the bid opening time. The telegraphic or written communications should not reveal the bid price; it should, however, state the addition or subtraction or other modification so that the final prices or terms will not be known by the County until the sealed bid is opened.

Bids, comments, or questions regarding the proposal should be submitted via the Public Purchase website.

6. **WITHDRAWAL OF BIDS**

- a. **PRIOR TO BID OPENING:** A bid may be withdrawn at any time prior to the time fixed in the Invitation to Bid for the opening of bids by filing with the Finance Director a written request for withdrawal executed by the bidder or his duly authorized representative. The withdrawal of such bid shall not preclude the bidder from filing a new bid.

- b. **AFTER BID OPENING:** Within **five (5) calendar days** after the opening of bids, a bidder may withdraw his bid providing he can establish to the County's satisfaction that a mistake was made in preparing the bid. A bidder desiring to withdraw shall give written notice to the County, specifying, in detail, how the mistake occurred and how the mistake made the bid materially different than it was intended to be. Withdrawal will not be permitted for mistakes resulting from errors in judgment or carelessness in inspecting the site of the work or in reading the project manual.
7. **MAJOR EQUIPMENT AND OTHER EQUIPMENT/MISCELLANEOUS ITEMS**

In the event that the County, at its sole discretion, determines that items selected by the Contractor and submitted for review does not meet the requirements of the contract, the Contractor shall select and submit for review equipment/item of another manufacturer which does meet the contract, and no increase in the total amount of the contract shall be allowed. The arrangements specified on the drawings are based on a particular manufacturer's equipment. Where the Contractor selects a manufacturer whose equipment arrangement is different than specified, the total amount listed in the bid shall provide for a complete operating installation for each equipment item listed, including any and all changes and additions in structure, piping, buildings, mechanical, electrical and control systems and accessories required to accommodate the listed manufacturer's equipment. The bid shall also include the preparation and submission of detailed drawings, calculations and manufacturer's data to allow evaluation of the proposed equipment and to show all modifications to the work as necessary to accommodate the proposed manufacturer's equipment.

B. ALTERNATIVE MATERIALS AND EQUIPMENT

In general, manufacturers or suppliers of materials and equipment may offer an alternative product to the Contractor and request that alternatives to specified products be considered equal. A substitution request must be submitted to the Project Manager no later than ten (10) calendar days before the bid opening in accordance with Section 00710, "General Terms and Conditions", paragraph 2.16. Inclusion of such alternatives in the bid is the responsibility of the Contractor. Inclusion should only be considered if the Contractor believes the offered alternative is equal in quality and performance to the specified product.

After award of contract, such offers of alternative products will be reviewed and processed as a substitution similar to Section 00710, "General Terms and Conditions", paragraph 2.16 as approved by the Construction Manager.

C. BID GUARANTY

The bid form shall be accompanied by a **Bid Bond** provided by a surety company authorized to do business in the State of Hawaii, for payment to the County of Maui, or, alternatively, by a certified or cashier's check, payable to the County of Maui. The bid bond shall be equal to at least **five percent (5%)** of the total amount of the bid submitted. The bid bond shall be provided on the form included in Section 00410 of this project manual. The amount payable to the County under the bid bond, or the certified or cashier's check and the amount thereof, as the case may be, shall be forfeited to the County as liquidated damages in case of a failure or neglect of the bidder to furnish, execute, and deliver to the County the required **Faithful Performance and Payment Bonds** provided respectively in **Sections 00610 and 00620**; evidences of insurance; and to enter into, execute, and deliver to the County the agreement on the form provided in **Section 00510**, within **ten (10) calendar days** after receiving written notice from the County that the award has been made and the agreement is ready for execution. A bid bond in excess of **\$40,000** shall only be a surety bond.

D. LIST OF SUBCONTRACTORS

Pursuant to provisions of Chapter 103D, HRS, as amended, each bidder shall have listed, on the form provided in Section 00430, the name, address, and description of the work, of each subcontractor to whom the bidder proposes to sublet portions of the work in excess of **one percent (1.0%)** of the total amount of his bid. For the purpose of this paragraph, a subcontractor is defined as one who contracts with the Contractor to provide materials and labor, labor only, or who specially fabricates and installs a portion of the work or improvement according to drawings contained in the project manual.

The work performed by all subcontractors shall not be greater than **50%** of the total bid price. Failure to list subcontractors shall render a bid nonresponsive and shall be grounds for rejection of the bid.

1.05 BIDDER'S CERTIFICATIONS

A. QUALIFICATIONS OF BIDDER

Bidder shall certify that he is, at the time of bidding, and shall be, throughout the period of the contract, licensed in accordance with Chapter 444, HRS, as amended, to do the type of work contemplated in the project manual. Bidder shall further certify that he is skilled and regularly engaged in the general class and type of work called for in the project manual.

The bidder also certifies that he is knowledgeable of the unusual and peculiar hazards associated with the general class and type of work required to construct the specified project within the terms given in the project manual. Bidder shall be competent and skilled in the protective measures necessary for the safe performance of the construction work with respect to such unusual and peculiar hazards.

The Bidder's attention is called to Act 52 requirements which require the following certificates:

1. A certificate of compliance (DLIR form LIR#27) issued by the Department of Labor and Industrial Relations stating that contractor complies with Chapters 383, 386, 392, and 393 of the HRS, current within **six (6) months** of issuance date. This certificate is required prior to an award of a contract.
2. A certificate of good standing from the business registration division of the Department of Commerce and Consumer Affairs (DCCA), current within **six (6) months** of issuance date. This certificate is required prior to an award of a contract.
3. A certificate of compliance for final payment affirming that the contractor has, as applicable, remained in compliance with all laws required by this section (3-122-112 HAR). This certificate is required prior to final payment of the contract.

B. ADDENDA

Addenda may be issued during the bidding period and they shall be incorporated into the Contract Documents.

Each proposal form shall include specific acknowledgment, in the space provided in **Section 00300**, of receipt of all addenda issued and mailed by the County during the bidding period. **Bidders shall also be responsible for confirming the existence of any addenda up until the day of the bid opening by checking the Public Purchase website.** Failure to so acknowledge may result in the bid being rejected as not responsive.

C. CONTRACTOR AND SUBCONTRACTOR LICENSING VERIFICATION PROCEDURE

1. All construction offer forms must contain blank lines to fill in contractors and subcontractors license numbers, and contractors must list not only their subcontractor's name, but also a valid license/class number as indicated on the DCCA contractor's licensing website at (<http://pvl.ehawaii.gov/pvlsearch/app>).

2. The Purchasing Division will verify the licenses of the contractor and all of the listed subcontractors on the State Website at (<http://pvl.ehawaii.gov/pvlsearch/app>), after our 2:00 p.m. bid opening and no later than the end of that workday. The Purchasing Division will also print out the license status for the contractor and each subcontractor listed and keep them in our bid file.
3. The Purchasing Division will also verify the licenses of the 2nd and 3rd lowest bidding contractor and their subcontractors in case the low bidder does not end up with the contract. If, for whatever reason, the County does not end up contracting with one of the 3 lowest bidders, the Purchasing Division will check the licenses of the other bidders, on a later date, and that verification date will be at the sole discretion of the Purchasing Division.
4. If a subcontractor is listed, and the license number is listed but not listed accurately, or numbers are transposed, etc., the Purchasing Division will have the sole discretion to accept or reject that contractor or subcontractor license based on our ability to quickly locate that license number on the state website using the license holder name, dba name, or any other information that we might have.
5. If the state contractor's licensing website is unavailable after the bid opening, or if the County of Maui Internet service is down, etc., the County of Maui has the sole discretion to verify licenses as soon as possible at a later date, but prior to the awarding of a contract.

D. ACT 68 OF 2010, SB 2840 – EMPLOYMENT OF STATE RESIDENTS ON CONSTRUCTION PROCUREMENT CONTRACTS

1. Act 68 of 2010 requires that a Contractor awarded any construction contract in excess of \$25,000 to have Hawaii residents compose no less than **eighty percent (80%)** of their workforce. This provision also applies to subcontracts in excess of \$50,000 in connection with any construction contract procured under HRS Chapter 103D.
2. For contract administration purposes, the Contractor will be required to submit a Certificate of Self Compliance on a monthly basis per Specification 00800, Sections 1.02 and 2.00.

E. SECTION 396-18 HRS. HEALTH AND SAFETY PROGRAMS.

1. Bidders for construction projects in excess of \$100,000 must include a signed certification **prior to award** that a written safety and health plan for the job will be available and implemented by the "Notice to Proceed" date of the project.

1.06 POSTPONEMENT OF OPENING

The County reserves the right to postpone the date and time for receiving and/or opening of bids at any time prior to the date and time established in the Invitation to Bid. Postponement notices shall be mailed to bidders in the form of addenda.

1.07 REJECTION OF BIDS

A. IRREGULAR BIDS

The County reserves the right to reject bids which are incomplete, obscure, or irregular; bids which omit a bid on any one or more items for which bids are required; bids which omit unit prices if unit prices are required; bids in which unit prices are unbalanced in the opinion of the County; bids accompanied by insufficient or irregular bid security; and bids from bidders who have previously failed to perform properly or to complete on time contracts of any nature.

B. COLLUSION

If the County has reason to believe that collusion exists among bidders, the County will reject the bids of the known participants in such collusion and may, at its option, require that all bidders certify under penalty of perjury that no collusion has occurred or exists. The County also, at its option, may reject all bids received.

1.08 RETURN OF BID GUARANTIES

Within **fifteen (15) calendar days** after the bids are opened, the County will return the bid guaranties accompanying the bids which are not to be considered in making the award. All other bid guaranties will be held until the contract has been fully executed; after which, they will be returned to the respective bidders whose bids they accompanied.

1.09 AWARD OF CONTRACT

Within **ninety (90) calendar days** after the date of opening bids, the County will act either to accept a bid or to reject all bids. Acceptance of a bid will be evidenced by a notice of award of contract in writing, delivered in person, or by certified mail, to the bidder whose bid is accepted. No other act of the County shall constitute acceptance of a bid. The award of contract shall obligate the bidder, whose bid is accepted, to furnish performance and payment bonds and evidences of insurance, and to execute the agreement set forth in the project manual.

The award will be made by the County on the basis of the Proposal from the lowest responsive, responsible Bidder. The award will be made on the basis of the Proposal submitted by the responsive, responsible Bidder submitting the lowest Proposal acceptable to the financing agency. In this case, the contract will be released by the County for signature by the qualified bidder after Notice of Award and upon the acceptance of his Proposal by the financing agency with the award period stated above under AWARD OF CONTRACT.

The County reserves the right to reject all Proposals, or any Proposal not in compliance with the Contract Documents, and to waive any informalities and irregularities in said Proposals.

1.10 EXECUTION OF CONTRACT

The contract agreement as provided in Section 00710 shall be executed in **quadruplicate** by the successful bidder and returned with the performance and payment bonds and evidences of insurance, within **ten (10) calendar days** after receiving written notice of the award of the contract. After execution by the County, one copy of the agreement shall be returned to the Contractor.

1.11 NOTICE TO PROCEED

The notice to proceed shall be issued within one hundred fifty (150) calendar days after execution of the contract by the County unless a later date is agreed to by mutual agreement. In the event that the notice to proceed is delayed beyond the one hundred fifty (150) calendar days or the time mutually agreed to, the contract amount may be adjusted in accordance with Section 8.02 of the County of Maui General Terms and Conditions for Construction Projects, or the County may terminate the contract for convenience. Upon thirty (30) calendar days from the executed Contract, the Contractor shall start submitting all project submittals and shop drawings for review and approval in accordance with the Special Provisions and the County of Maui General Terms and Conditions for Construction Projects

1.12 LABOR REQUIREMENTS

A. WAGE DETERMINATION

Wages to be paid laborers and mechanics on this project shall be no less than the minimum prevailing wage as determined by the Director of Labor and Industrial Relations in accordance with Chapter 104, HRS, as amended and as contained in the minimum wage rate schedule.

A copy of the current minimum wage rate schedule can be downloaded at the Hawaii Department of Labor website:

<http://labor.hawaii.gov/rs/home/wages/72-2/>

The County does not guarantee that labor can be procured for the rates shown in the wage rates. The wage rates are minimum below which the Contractor cannot pay. They do not constitute a representation that labor can be procured for the minimum listed.

The Wage Rate is subject to change at any time by the Department of Labor and Industrial Relations. Any such change, notice of which is received by the County **six (6) or more calendar days** prior to the opening of bids, shall be conformed with.

The successful bidder shall be responsible for submission to the County the certified copies of the payrolls and signed statements of compliance for themselves and all subcontractors.

B. SAFETY AND HEALTH REGULATIONS FOR CONSTRUCTION

The Contractor shall comply with all state and federal laws and county and local ordinances and regulations which in any manner affect those engaged or employed in the work.

1.13 NONDISCRIMINATION IN EMPLOYMENT

The Contract for work under this Proposal obligates the Bidder and any subcontractor not to discriminate in employment practices.

Bidders must, if requested, submit a compliance report from the subcontractors who will perform work on the project, a signed statement, with supporting evidence, from authorized labor pool agents, from which they may seek employees for the work, stating that the practices and policies of said labor pools are in conformity with Executive Order No. 11246, as amended, and that said labor pool will affirmatively cooperate in, or offer no hindrance to, the recruitment, employment, and equal treatment of employees seeking employment and performing work under the contract; or certification that efforts have been made to secure said statements when such agents or labor pools have failed or refused to furnish same prior to the award of the Contract.

1.14 PREFERENCE FOR HAWAII PRODUCTS

[REPEALED SB 2384]

1.15 TAX CLEARANCE FOR BID PREPARATION

An original or certified copy of a tax clearance issued by the Hawaii State Department of Taxation (DOTAX) and the Internal Revenue Service (IRS) **shall be submitted with your sealed offer** by the due date and time. The tax clearance shall be obtained on the two-part Tax Clearance Application (Form A-6 - available from the Maui District or other State Tax Offices) that combines DOTAX and IRS tax clearances. The tax clearance shall be valid for **six (6) months**.

Note: The above tax clearance requirement is in addition to the existing requirement for final payment. Refer to the special provisions on invoicing for information on the tax clearance requirements for final payment.

1.16 ACT17, SLH 2009 - APPRENTICESHIP PROGRAMS ON PROJECTS OVER \$250,000

The Apprenticeship Program Preference pursuant to Act 17, SLH 2009 is applicable to this project. Bidders with apprenticeship programs that are registered with the State of Hawaii Department of Labor and Industrial Relations may apply for a **preference of 5%** for projects that the County of Maui estimates will be \$250,000.00 or more.

In order to obtain the 5% preference, a Certification Form 1 must be completed and submitted with the bid proposal. The form can be found in Section 01999 – Reference Forms.

Details and procedures shall be in accordance with the State of Hawaii Comptroller's Memorandum No. 2022-20, which can be found at the following link:

<https://ags.hawaii.gov/wp-content/uploads/2023/01/CM2022-20.pdf>

1.17 COUNTY GENERAL CONDITIONS, HRS CHAPTER 103D, HAR TITLE 3

Bidder acknowledges that the County of Maui General Terms and Conditions for Construction as well as HRS Chapter 103D, and HAR Title 3 rules apply to this procurement.

END OF SECTION

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SECTION 00300

PROPOSAL

Director of Finance
County of Maui
Kalana O Maui Building
200 South High Street
Wailuku, Hawaii 96793

The undersigned, as bidder, declares that we have received and examined the project manual entitled "**LIPOA WASTEWATER PUMP STATION, COUNTY JOB NO. WW19-02**", and will contract with the County, on the form of agreement provided herewith, to do everything required for the fulfillment of the contract for the construction of the "**LIPOA WASTEWATER PUMP STATION, COUNTY JOB NO. WW19-02**", at the prices and on the terms and conditions herein contained.

We agree that the contract documents include Parts A, B, and C of this project manual as well as the referenced federal, state, and local agency requirements.

We agree that the following shall form part of his bid:

<u>Section</u>	<u>Title</u>
00300	Proposal
00310	Bidding Schedule
00410	Bid Bond
00423	Certification of Bidder's Experience and Qualifications
00430	Proposed Subcontractor(s)

If applying for a 5% preference under Act 17, SLH 2009 (Apprenticeship Program Preference), a completed Certification Form 1 must be included in the proposal form. Copy of Certification Form 1 is provided in Section 01999 – Reference Forms, and is also available from the Hawaii Department of Industrial Relations website at:

<http://labor.hawaii.gov/wdd/home/employers/apprenticeship/resources/>

We acknowledge that addenda numbers _____ through _____ have been received and have been examined as part of the project manual.

We the Bidders acknowledge that we are responsible for confirming the existence of any addenda up until the day of the bid opening by calling the County of Maui Purchasing Division at (808) 249-2403. Bidders shall also be responsible for confirming the existence of any addenda up until the day of the bid opening by

checking the Public Purchase web. Failure to so acknowledge may result in the bid being rejected as not responsive.

Attached is a **Bid Bond** duly completed by a guaranty company authorized to carry on business in the State of Hawaii, or alternatively, there is attached a certified or cashier's check payable to the County.

If our bid is accepted, we agree to sign the agreement without qualifications and to furnish the performance and payment bonds and the required evidences of insurance within **ten (10)** calendar days after receiving written notice of the award of the contract.

We further agree, if our bid is accepted and a contract for performance of the work is entered into with the County, to so plan work and to prosecute it with such diligence that the work shall be completed within the time stipulated.

If the work is not completed within the time stipulated, the County shall be entitled to claim **liquidated damages**. We agree that it is difficult to determine actual damages and therefore agree to damages fixed at the sum of **five hundred dollars (\$500)** for each and every calendar day the substantial completion of the work under the contract is delayed, and we expressly waive our right to claim that the liquidated damages amount to a penalty or are in the nature of a penalty and the County need not show or prove actual damages in claiming said liquidated damages.

(Seal)

Name of Bidder

Contractor's License Number

License Expiration Date

Signature of Bidder

Signature of Witness

Title of Signator

Title of Witness

Address of Bidder

Email Address of Bidder (Optional)

State of Incorporation

Phone Number of Bidder

END OF SECTION

SECTION 00310

BIDDING SCHEDULE

The Contractor hereby certifies that the cost of all labor, equipment, tools, materials, and taxes necessary for the proper completion of the work, as described in the plans and specifications herein, shall be included in the lump sum prices below:

Item No.	Estimated Quantity	Description	Unit Price	Total Amount
1.	LS	Mobilization.	Lump Sum	\$ _____
2.	LS	Erosion, sediment and dust control, in place complete.	Lump Sum	\$ _____
3.	LS	Earthwork,(excluding wet well structure) including non-rock excavation, trenching, shoring, dewatering, disposal, backfill, grading, and other 02300 items, in-place, complete.	Lump Sum	\$ _____
4.	LS	Wet well structure, including non-rock and rock excavation, shoring, dewatering, disposal, backfill, grading, coating, access hatches, rolling A-frame gantry, discharge piping concrete pad and appurtenances, in-place, complete.	Lump Sum	\$ _____
5.	LS	Submersible pumps, including three submersible pumps, guiderails, testing, startup, and training, in-place, complete.	Lump Sum	\$ _____
6.	LS	Wastewater and water pipes and valves, inclusive of forcemain, drain lines, flow meter, and water lines, in-place, complete.	Lump Sum	\$ _____
7.	LS	Odor control system, inclusive of odor control unit, piping, valves, concrete pad, in-place complete.	Lump Sum	\$ _____

8.	LS	Electrical building, including structure, architectural, and HVAC features, lighting, and instrumentation equipment, in-place, complete.	Lump Sum	\$ _____
9.	LS	Generator and aboveground fuel storage tank, including structural pad, fuel day tank, pumps, alarms, fuel piping and valves, testing, startup, and training, in-place, complete.	Lump Sum	\$ _____
10.	LS	Electrical, instrumentation, and controls improvements, in-place complete.	Lump Sum	\$ _____
11.	LS	SCADA integration, in-place complete.	Lump Sum	\$ _____
12.	LS	Testing and commissioning, including startup and testing of all equipment for proper functionality and performance, operational testing, developing Operations and Maintenance Manual, training, commissioning of entire facility demonstrating all aspects of work are functioning as designed, in-place complete.	Lump Sum	\$ _____
13.	LS	Site improvements and restoration, including, demolition, A.C. paving, curbs, gutters, gravel surfacing, fencing and gates, yard piping (excluding trenching), sewer manholes, surface restoration, traffic control, in-place, complete.	Lump Sum	\$ _____
14.	LS	Irrigation system restoration, including pre-construction irrigation system survey, and restoration of irrigation system as indicated on the Drawings.		
15.	LS	Demobilization.	Lump Sum	\$ _____

16.	LS	Paving allowance (for repairs to paving not on the pump station site).	Lump Sum	\$ _____
17.	LS	Archeological Monitoring allowance (for archeological monitoring services to meet requirements of Section 01560)	Lump Sum	\$ _____
18.	LS	Site work rock excavation allowance (for site work rock excavation, exclusive of wet well rock excavation)	Lump Sum	\$ _____
19.		Contingency		\$ _____ \$1,000,000
20.		TOTAL SUM (Item 1-19)	\$_____	
21.	APPRENTICESHIP PROGRAM CREDIT [5% of 20 above] <i>Page 01999-9 included in bid proposal</i> Enter "0" if not applicable			\$ _____
22.	AMOUNT FOR COMPARISON OF BID (Item 20 minus 21)			

\$ _____ Dollars (\$ _____).

PERFORMANCE INCENTIVE:

The Bidder Understands and agrees that the County of Maui reserves the right to decrease or delete any item or portion of the work as may be required prior to the award of the contract due to budget constraints and that the Bidder will make no claims for anticipated profit or compensation because of the decrease or deletion of work. **The Winning Bidder will be selected based solely on the above AMOUNT FOR COMPARISON OF BID (ITEM 22).** The original low bidder will be awarded the contract even if another bidder has a lower AMOUNT FOR COMPARISON OF BID price due to increase or decrease or deletion of work.

END OF SECTION

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SECTION 00410

BID BOND

Bond No. _____

KNOW TO ALL BY THESE PRESENTS:

That we,

_____,
(Full Name or Legal Title of Offeror)

as Offeror, hereinafter called Principal, and

_____,
(Name of Bonding Company)

as Surety, hereinafter called Surety, a corporation authorized to transact business as a Surety in the State of Hawaii, are held and firmly bound unto the County of Maui, hereinafter called Owner, in the penal sum of five percent (5%) of the total amount of the bid of the Principal for the work of lawful money of the United States of America, for the payment of which sum well and truly to be made, the said Principal and the said Surety bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS:

The Principal has submitted an offer for the “**LIPOA WASTEWATER PUMP STATION, COUNTY JOB NO. WW19-02**”.

NOW, THEREFORE:

The condition of this obligation is such that if the Owner shall reject said offer, or in the alternate, accept the offer of the Principal and the Principal shall enter into a Contract with the Owner in accordance with the terms of such offer, and give such bond or bonds as may be specified in the solicitation or Contract Documents with good and sufficient surety for the faithful performance of such Contract and for the prompt payment of labor and material furnished in the prosecution thereof as specified in the solicitation then this obligation shall be null and void, otherwise to remain in full force and effect.

(Continued Next Page)

Signed and sealed this _____ day of _____, _____.

(Seal)

Name of Principal (Offeror)

Signature

Title

(Seal)

Name of Surety

Signature

Title

END OF SECTION

SECTION 00423

CERTIFICATION OF BIDDER'S EXPERIENCE AND QUALIFICATIONS

The undersigned bidder certifies that he is, at the time of bidding, and shall be, throughout the period of the contract, licensed by the State of Hawaii to do the type of work required under terms of the Contract Documents. Bidder further certifies that he is skilled and regularly engaged in the general class and type of work called for in the Contract Documents.

In accordance with the requirements of **Paragraph 00100-1.05 A**, the bidder represents that he is competent, knowledgeable, and has special skills on the nature, extent, and inherent conditions of the work to be performed. Bidder further acknowledges that there are certain peculiar and inherent conditions existent in the construction of the particular facilities which may create, during the construction program, unusual or peculiar unsafe conditions hazardous to persons and property. Bidder expressly acknowledges that he is aware of such peculiar risks and that he has the skill and experience to foresee and to adopt protective measures to adequately and safely perform the construction work with respect to such hazards.

Signed this _____ day of _____, 20____.

Name of Bidder

Contractor's License No. and State

Signature of Bidder

Title of Signator

END OF SECTION

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SECTION 00430
PROPOSED SUBCONTRACTORS

The following information gives the name, license number, business address, and portion of work (description of work to be done) for each subcontractor that will be used in the work if the bidder is awarded the contract. No subcontractor doing work in excess of 1 percent of the total amount of the bid and who is not listed shall be used without the written approval of the Owner. (Additional supporting data may be attached to this page. If a license number is not provided for each subcontractor, the bidder shall provide evidence that (1) they hold a license for the specialty work to be done, OR (2) that the specialty work is less than one percent (1.0%) of the total amount of the bid. Each page shall be sequentially numbered, e.g., 00430-2, and headed "Proposed Subcontractors" and shall be signed.) Failure to list subcontractors shall render a bid nonresponsive and shall be grounds for rejection of the bid.

<u>Name</u>	<u>License No.</u>	<u>Business Address</u>	<u>Description of Work</u>

Signature of Bidder

END OF SECTION

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SECTION 00510

AGREEMENT

THIS AGREEMENT, made this _____ day of _____, 20____, by and between the County of Maui, Hawaii, hereinafter called the "Owner," and _____, hereinafter called the "Contractor."

WITNESSETH:

WHEREAS, the Owner has caused a project manual to be prepared comprised the parts and addenda described below for the construction of the "**LIPOA WASTEWATER PUMP STATION, COUNTY JOB NO. WW19-02**" as described therein, and

WHEREAS, the Contractor has offered to perform the proposed work in accordance with the terms of the contract as defined in Paragraph **00710-1.04** of the specifications.

NOW, THEREFORE, in consideration of the mutual covenants and agreements of the parties contained in the contract and to be performed, the Contractor hereby agrees to complete the work at the price and on the terms and conditions therein contained, and the Owner agrees to pay the Contractor the contract price provided therein for the fulfillment of the work and the performance of the covenants set forth herein.

The further terms, conditions, and covenants of this agreement are set forth in the contract documents, each of which is attached hereto and by this reference made a part hereof:

Part A	Bidding and Contract Documents		
Part B	Technical Specifications		
Part C	Construction Drawings		
Addenda Number		through	

(Bidder Signature on Next Page)

IN WITNESS WHEREOF, this agreement has been executed on this _____ day of
_____, 20__.

Signature for Owner

Title of Signator

Attest: _____
Signature

Title of Signator

Name of Contractor

Signature for Contractor

Title of Signator

END OF SECTION

SECTION 00581

MINIMUM WAGE RATES

1.01 DESCRIPTION

A copy of the current Wage Rate Schedule, Equipment Operators Classification Groups, and Apprentice Schedule can be downloaded at the Hawaii Department of Labor website:

<https://labor.hawaii.gov/rs/home/wages/wage-rate-schedule/>

The County does not guarantee that labor can be procured for the rates shown in the wage rates. The wage rates are minimum below which the Contractor cannot pay. The wage rates do not constitute a representation that labor can be procured for the minimum listed.

The Wage Rate is subject to change at any time by the Department of Labor and Industrial Relations. Any such change, notice of which is received by the County **six (6) or more calendar days** prior to the opening of bids, shall be conformed with.

The contractor shall pay all laborers and mechanics engaged in the performance of this Agreement on the job site not less than the latest minimum wage rates, as promulgated by the State Department of Labor and Industrial Relations.

The minimum wages that shall be paid to the various classes of laborers and mechanics engaged in the performance of the Agreement on the job site **shall be periodically increased** during the performance of the contract in an amount equal to the increase in the prevailing wages for those kinds of work as periodically determined by the Director of Labor and Industrial Relations. **Contractor shall bear the cost of any such increase** and shall have no recourse against County for such increase.

The Contractor shall pay all mechanics and laborers on the job site not less than once a week, and shall compensate any such mechanic or laborer who works on weekends, holidays or in excess of **eight (8) hours** in one day, at the rate **of one and one-half (1.5)** times his basic hourly rate. **Certified copies of all payrolls shall be submitted weekly to the Construction Manager or the Director's designated representative.**

Certified Payrolls submitted to the County shall:

1. Clearly identify each worker by name, address, classification and at least the last four (4) digits of his/her Social Security number.
2. Designate each worker in a classification that **exactly** matches a classification shown on the State's Wage Rate Schedule.
3. Show number of hours worked (regular and overtime) by each worker.
4. Show the worker's wage rate and dollar amount paid.
5. Show detailed deduction information and proof that those deductions were made on the worker's behalf.

The Contractor shall prominently post a "**Notice to Employees**" poster and the prevailing Wage Rate Schedule at the jobsite, where it is clearly visible and accessible to the workers.

A copy of the current "*Notice to Employees*" poster can be found at the Hawaii Department of Labor website:

<http://labor.hawaii.gov/labor-law-poster/>

The County may withhold payments from the Contractor as it deems necessary to pay to laborers and mechanics employed on the job site the wages required hereunder.

The failure of the Contractor or any subcontractor to pay the required wages shall be cause for termination, in which event the Contractor and its sureties shall be liable for any excess costs to complete the work contracted for hereunder.

1.02 QUALITY ASSURANCE

A. SUBMITTALS:

In accordance with specification Section 01300, "SUBMITTALS," and in addition to the requirements of that section, the following submittals shall be provided:

1. Weekly Certified Payrolls

END OF SECTION

SECTION 00610

FAITHFUL PERFORMANCE BOND

KNOW TO ALL BY THESE PRESENTS:

That

(Full Legal Name and Street Address of Contractor)

as Contractor, hereinafter called Principal, and

(Name and Street Address of Bonding Company)

as Surety, hereinafter called Surety, a corporation(s) authorized to transact business as a surety in the State of Hawaii, are held and firmly bound unto the County of Maui, its successors and assigns, hereinafter called Obligee, in the amount of:

DOLLARS (\$),
to which payment Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the above-bound Principal has signed a Contract with Obligee on _____, for the following project: "**LIPOA WASTEWATER PUMP STATION, COUNTY JOB WW19-02**" hereinafter called Contract, which Contract is incorporated herein by reference and made a part hereof.

NOW THEREFORE, the condition of this obligation is such that:

If the Principal shall promptly and faithfully perform, and fully complete the Contract in strict accordance with the terms of the Contract as said Contract may be modified or amended from time to time; then this obligation shall be void; otherwise to remain in full force and effect.

Surety to this Bond hereby stipulates and agrees that no changes, extensions of time, alterations, or additions to the terms of the Contract, including the work to be performed thereunder, and the specifications or drawings accompanying same, shall in any way affect its obligation on this bond, and it does hereby waive notice of any such changes, extensions of time, alterations, or additions, and agrees that they shall become part of the Contract.

In the event of Default by the Principal, of the obligations under the Contract, then after written Notice of Default from the Obligee to the Surety and the Principal and subject to

the limitation of the penal sum of this bond, Surety shall remedy the Default, or take over the work to be performed under the Contract and complete such work, or pay moneys to the Obligee in satisfaction of the surety's performance obligation on this bond.

Signed and sealed this _____ day of _____, _____.

(Seal)

Name of Principal (Contractor)

* Signature

Title

(Seal)

Name of Surety

* Signature

Title

*** ALL SIGNATURES MUST BE ACKNOWLEDGED BY A NOTARY PUBLIC**

END OF SECTION

SECTION 00620

PAYMENT BOND

KNOW TO ALL BY THESE PRESENTS:

That

(Full Legal Name and Street Address of Contractor)

as Contractor, hereinafter called Principal, and

(Name and Street Address of Bonding Company)

as Surety, hereinafter called Surety, a corporation(s) authorized to transact business as a surety in the State of Hawaii, are held and firmly bound unto the County of Maui, its successors and assigns, hereinafter called Obligee, in the amount of:

 Dollars (\$),
to which payment Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the above-bound Principal has signed Contract with the Obligee on
 for the following project: "**LIPOA WASTEWATER PUMP
STATION, COUNTY JOB NO. WW19-02**" hereinafter called Contract, which Contract is incorporated herein by reference and made a part hereof.

NOW THEREFORE, the condition of this obligation is such that if the Principal shall promptly make payment to any Claimant, as hereinafter defined, for all labor and materials supplied to the Principal for use in the performance of the Contract, then this obligation shall be void; otherwise to remain in full force and effect.

1. Surety to this Bond hereby stipulates and agrees that no changes, extensions of time, alterations, or additions to the terms of the Contract, including the work to be performed thereunder, and the specifications or drawings accompanying same, shall in any way affect its obligation on this bond, and it does hereby waive notice of any such changes, extensions of time, alterations, or additions, and agrees that they shall become part of the Contract.
2. A "Claimant" shall be defined herein as any person who has furnished labor or materials to the Principal for the work provided in the Contract.

Every Claimant who has not been paid amounts due for labor and materials furnished for work provided in the Contract may institute an action against the Principal and its Surety on this bond at the time and in the manner prescribed in Section 103D-324, Hawaii

Revised Statutes, and have the rights and claims adjudicated in the action, and judgment rendered thereon; subject to the Obligee's priority on this bond. If the full amount of the liability of the Surety on this bond is insufficient to pay the full amount of the claims, then after paying the full amount due the Obligee, the remainder shall be distributed pro rata among the claimants.

Signed and sealed this _____ day of _____, _____.

(Seal)

Name of Principal (Contractor)

* Signature

Title

(Seal)

Name of Surety

* Signature

Title

***ALL SIGNATURES MUST BE ACKNOWLEDGED BY A NOTARY PUBLIC**

END OF SECTION

SECTION 00710
GENERAL TERMS AND CONDITIONS

INTRODUCTION

A copy of the *County of Maui General Terms and Conditions for Construction Projects*, revised November 11, 2023, is included herein.

The General Terms and Conditions are also available online at the County of Maui Website:

<https://www.mauicounty.gov/DocumentCenter/View/3181/Construction-and-Bond--GTC>

Amendments to the General Terms and Conditions can be found in **Section 00800-Supplementary Conditions, Paragraph 1.02**.

COUNTY OF MAUI
GENERAL TERMS AND CONDITIONS

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**COUNTY OF MAUI
GENERAL TERMS AND CONDITIONS
CONSTRUCTION CONTRACTS**

Preface

The General Terms and Conditions of the County of Maui, incorporated by reference in the solicitation document and the awarded contract, referred to as the “GTC” or “General Conditions,” represent the County’s policy and requirements relating to contracts as authorized by Hawaii Revised Statutes (HRS), Chapter 103D, and its promulgated rules under Hawaii Administrative Rules (HAR), Title 3, Department of Accounting and General Services (collectively referred to as the “Procurement Code”). References to HRS and/or HAR provisions in the GTCs are included for convenience only and may not be complete. Should any contractual term herein be inconsistent with the Procurement Code, the Procurement Code shall govern. Contractors should familiarize themselves with the Procurement Code.

Section 1 – Definitions

When used in these General Terms and Conditions or elsewhere in the Contract, the following terms, or pronouns used in place of them, shall have the meaning ascribed to them in this Section, unless it is apparent from the context that a different meaning is intended:

1.01 “Addendum (plural-Addenda)” means a written or graphic document, including drawings and specifications, issued by the Procurement Officer during the bidding period which modifies or interprets the bidding documents by additions, deletions, clarifications, or corrections which document shall be considered and made a part of the contract when executed.

1.02 “Bid Documents” mean the composition of the notice to bidders, instructions to bidders, bid proposal form, general terms and conditions, special provisions, construction plans, specifications, and all addenda issued prior to opening of bids.

1.03 “Calendar Day” means any day shown on the calendar, beginning at midnight and ending at midnight of the following day. If no designation of calendar or working day is made, “day” shall mean calendar day.

1.04 “Contract Documents” mean the composition of general terms and conditions, special provisions, construction plans, specifications, addenda, Contractor's bid proposal, notice of award, executed contract, contract amendments, Contractor's performance and payment bonds, Notice to Proceed, and change orders.

1.05 “Time of Performance” means the number of calendar days or working days provided in the contract for the completion of the work. The contract time shall commence on the effective date of the Notice to Proceed.

1.06 “County” means the County of Maui.

1.07 “Equipment” means all machinery, tools, and apparatus necessary to complete the work under the contract.

1.08 “HAR” means Hawaii Administrative Rules, as amended.

1.09 “Hazardous Materials” mean and include any and all radioactive materials, asbestos, organic compounds known as polychlorinated biphenyls, chemicals known to cause cancer or reproductive toxicity, hazardous wastes, toxic substances, and any and all other substances or materials defined as “hazardous materials,” “extremely hazardous materials,” “hazardous wastes” or “toxic substances” under or for the purposes of hazardous materials laws.

1.10 “Hazardous Materials Laws” mean and include all federal, state or local laws, ordinances, rules, regulations or codes, now or hereafter in effect, relating to environmental conditions, human health or industrial hygiene, including but not limited to the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended, 42 U.S.C. Section 9601, et seq., the Resource Conservation and Recovery Act, 42, U.S.C. Section 6901, et seq., the Hazardous Materials Transportation Act, 42 U.S.C. Section 1801, et seq., the Clean Water Act, 33 U.S.C. Section 1251 et seq., the Clean Air Act, 42 U.S.C. 7401 et seq., the Toxic Substances Control Act, 15 U.S.C. Section 2601 - 2629, the Safe Drinking Water Act, 42, U.S.C. Sections 300f - 300j, HRS Chapter 128D, Environmental Response Law, HRS Chapter 342B, Air Pollution Control, HRS Chapter 342D, Water Pollution, HRS Chapter 342H, Solid Waste Pollution, HRS Chapter 342J, Hazardous Waste, HRS Chapter 342L, Underground Storage Tanks, Chapter 342P, Asbestos, and any similar state or local laws or ordinances and the regulations now in effect or hereafter adopted, published or promulgated thereto.

1.11 “**HRS**” means Hawaii Revised Statutes, as Amended.

1.12 “**Inspector**” means the County’s authorized representative assigned to make detailed inspections of contract performance, prescribed work, and materials supplied.

1.13 “**Liquidated Damages**” mean the amount set forth in the contract to be paid by the Contractor to the County for each and every day the work remains uncompleted beyond the contract time.

1.14 “**Lowest Responsive, Responsible Bidder**” means the bidder who has the capability in all respects to perform fully the contract requirements, the integrity and reliability which will assure good faith performance and who has submitted the lowest bid which confirms in all material respects to the invitation for bids.

1.15 “**Notice to Proceed**” means the written notice given by the Officer-in-Charge to the Contractor designating the official commencement date of the performance under the contract.

1.16 “**Overhead**” means continuous or general costs occurring in the normal course of business, including but not limited to costs for labor, rent, royalties, interest, discounts paid, insurance, bonds, lighting, heating, cooling, accounting, legal fees, equipment and facilities, telephone systems, depreciation, and amortization.

1.17 “**Payment Bond**” means the security executed by the Contractor and the Contractor’s sureties and furnished to the County to guarantee payment by the Contractor to laborers, materials suppliers, and subcontractors according to the terms of the contract.

1.18 “**Performance Bond**” means the security executed by the Contractor and the Contractor’s securities and furnished to the County to guarantee the completion of the work according to the terms of the contract.

1.19 “**Plans or Drawings**” means any and all designs, plans, construction drawings, specifications, cost estimates, work schedules, proposals, studies, reports, notes, tables, notations and other similar items which show the location, character, dimension, and details of the work to be completed under the contract, including the current and applicable portions of the Water System Standards 2002, as amended, for Department of Water Supply contracts.

1.20 “**Procurement Officer**” means the Director of the Department of Finance of the County of Maui, acting directly or through the Director’s duly authorized representative.

1.21 “**Shop Drawings**” mean the drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by the Contractor and submitted by the Contractor to illustrate some portion of the work.

1.22 “**Special Provisions**” or “**Special Conditions**” are the means by which the general terms and conditions are amended.

1.23 “**State**” means the State of Hawaii

1.24 “**Subcontractor**” means any person who enters into an agreement with the Contractor to perform a portion of the work for the Contractor

1.25 “**Surety**” means the qualified individual or entity, other than the Contractor, that insures the Contractor’s acceptable performance of the contract.

1.26 “Total Sum Bid” means the total bid price submitted by the bidder for performing all work in accordance with the contract.

1.27 “Work” means the furnishing of all labor, materials, equipment, and other incidentals necessary or convenient for the successful completion of the construction project and the execution of all duties and obligations imposed by the contract on the Contractor.

1.28 “Working Day” means a calendar day in which the Contractor is capable of working four (4) or more hours with its normal work force, exclusive of:

(a) Saturdays, Sundays, and State/County recognized legal holidays;

(b) Days in which work is suspended by the County for four (4) or more hours through no fault of the Contractor; and

(c) Days prevented by or resulting from inclement weather to permit the normal work force to proceed with construction operations for at least four (4) hours. Also the Contractor shall be performing the current controlling item or items of work.

Section 2 – Bidding Instructions

2.01 Obtaining Bid Documents. Bidders shall refer to the notice to bidders for instructions in obtaining bid documents.

2.02 Proposal Forms. The County will furnish prospective bidders with proposal forms. Papers bound with or attached to the proposal form are part of the proposal. The bidder shall not detach or alter these papers when submitting its bid. The bidder shall also consider other documents, including the plans and specifications, a part of the proposal form whether attached or not.

2.03 Contractor’s License Required. All bidders and all their subcontractors shall be licensed in accordance with Chapter 444, HRS, and as required in the notice to bidders. It is the sole responsibility of the bidder to review the requirements of the project and determine the appropriate licenses that are required to complete the project.

2.04 Qualifications of Bidders. (a) The Procurement Officer shall determine whether the prospective bidder has the financial ability, resources, skills, capability, and business integrity necessary to perform the work. For this purpose, the Procurement Officer, in the Procurement Officer's discretion, may require any prospective bidder to submit answers, under oath, to questions contained in a standard form of questionnaire. Whenever it appears from the answers to the questionnaire or otherwise, that the prospective bidder is not fully qualified and able to perform the work, a written determination of non-responsibility of a bidder shall be made by the Procurement Officer. The reasonable failure of a bidder to promptly supply information in connection with an inquiry with respect to responsibility may be grounds for a determination of non-responsibility with respect to such bidder. The decision of the Procurement Officer shall be final unless the bidder applies for administrative review pursuant to Section 103D-709, HRS. [§103D-310, HRS]

(b) Questionnaires, when required by the Procurement Officer, shall be submitted not less than forty-eight (48) hours prior to the time designated for opening of bids.

(c) All bidders shall be incorporated or organized under the laws of the State of Hawaii, or be registered to do business in the State as a separate branch or division that is capable of fully

performing under the contract. The bidder shall be in compliance with all laws governing entities doing business in the State. [§103D-310, HRS]

2.05 Preparation of Bids. (a) Bids shall be submitted on the proposal form furnished by the County. The bidder shall complete the proposal using words and figures, which shall be in ink or typed. If a discrepancy occurs between the prices written in words and those written in figures, the prices written in words shall govern.

(b) Bids must be signed in ink by a duly authorized representative of the bidder on the spaces provided for signatures.

(c) If the bidder is a corporation, the title or titles of the person or persons signing must be stated and the corporate seal affixed thereto. If the corporation does not have a corporate seal, it should be indicated in the form of acknowledgment attached thereto. A copy of a resolution of the Board of Directors of the corporation, or other written evidence of authority signed by an officer of the corporation, authorizing the person or persons to execute bids, contracts, and other necessary documents in connection therewith shall be attached.

(d) Where the bidder is an association or group, the title or titles of the person or persons signing must be stated and an affidavit which acknowledges the authority of the signer or signers to sign bids and all other necessary documents in connection therewith for the association or group must be attached.

(e) Bids must be submitted in a sealed envelope, bearing on the outside the identity of the project and the bidder's name and address. Bids will be received only at the office designated in the notice to bidders. All bid envelopes will be stamped with the time and date received by the County. The County will reject and return a bid unopened if received after the time set for opening of bids.

2.06 Listing of Joint and Subcontractors. (a) The names of each person or entity to be engaged by the bidder as a joint Contractor or subcontractor and the nature and scope of work to be performed by each shall be submitted with the bidder's proposal. Bids that do not comply with this requirement may be accepted if acceptance is in the best interest of the County and the value of work to be performed by the joint Contractor or subcontractor is equal to or less than one percent (1%) of the total bid amount. [§103D-302, HRS]

(b) If no joint Contractor or subcontractor is to be engaged, the bidder must complete the form by writing "NONE." If left blank, the County will interpret the blank as no joint contractor or subcontractor will be used.

2.07 Examination of the Bid Documents and Project Site, and Conducting Investigations. (a) Before submitting a bid, bidders shall examine the bid documents and the project site, make inquiries at the appropriate offices of the County, State, and Federal governments, and the offices of persons and entities owning, controlling, or operating underground improvements, and conduct investigations to satisfy themselves as to the conditions to be encountered and to determine the correctness of the information contained in the bid documents.

(b) The submission of a bid shall be considered verification that the bidder:

(1) Has made such examinations and inquiries;

(2) Is satisfied with the conditions to be encountered in performing the work;

- (3) Acknowledges and understands the terms and conditions contained in the bid documents; and
- (4) Agrees to abide by such terms and conditions if awarded the contract.

2.08 Subsurface Investigations. (a) If the County has conducted subsurface investigations, bidders may inspect the data obtained from such investigations and examine samples, if available.

(b) Any subsurface information made available are for the bidders' convenience only. The information may have been obtained at specific locations, and no assurance is given that these conditions are necessarily typical of conditions at other locations. In addition, no assurance is given that conditions found at the time of the subsurface explorations, such as the presence or absence of water, will be the conditions that will prevail at the time of construction. The bidder shall be responsible for all assumptions, deductions, or conclusions made or derived from the subsurface information made available.

(c) Making available to bidders information from the subsurface explorations is not to be construed as a waiver of Subsection 2.07 - Examination of Bid Documents and Project Site, and Conducting of Investigations.

2.09 Pre-bid Conferences. At least fifteen days prior to submission of bids pursuant to an invitation for bids for a construction or design-build project with a total estimated contract value of \$500,000 or more, and at least fifteen days prior to submission of proposals pursuant to a request for proposals for a construction or design-build project with a total estimated contract value of \$100,000 or more, the head of the purchasing agency shall hold a pre-bid conference and shall invite all potential interested bidders, offerors, subcontractors, and union representatives to attend. The County may, for projects that have special or unusual requirements, [e.g., requiring physical inspection,] make attendance at a pre-bid conference a condition for submitting a bid. Pre-bid conferences shall be announced to all prospective bidders in the notice to bidders. Nothing stated at the pre-bid conference shall change the solicitation unless a change is made by written addendum as provided in Subsection 2.11 - Addenda.

2.10 Clarification of Bid Documents. (a) If it appears to a bidder that the performance of the work or any matter relating thereto is not sufficiently described or explained in the bid documents, or that a discrepancy exists between different parts thereof, or that the full intent of the bid documents is not clear, the bidder shall submit a written request to the Procurement Officer for clarification not less than ten (10) calendar days prior to the day designated for opening of bids.

(b) The written request may be faxed pursuant to Subsection 2.19 – Use of Facsimiles.

(c) If the Procurement Officer deems that a clarification is in order, it shall be issued in the form of an addendum.

2.11 Addenda. (a) Any addendum issued prior to the opening of bids shall be binding upon the bidder and shall be made a part of the contract.

(b) No addendum will be issued during the five (5) days immediately preceding the day designated for the opening of bids, unless the purpose of the addendum is to postpone the date of bid opening.

(c) Failure by the bidder to receive any addendum shall not relieve the bidder from any obligation under its bid as submitted.

(d) No oral interpretation, instruction, or information regarding the bid documents given by any officer or employee of the County shall be binding.

2.12 Determination of Intended Bid. (a) If the proposal form contains a list of unit price or lump sum items, or both, they do not necessarily describe all of the work involved in the performance of the contract, but merely indicate that the compensation for the performance of the contract will be based upon and limited to such items. If a bidder is in doubt as to the proper bid item to which the anticipated cost of any incidental item is to be allocated, the bidder shall include such cost in the bid item which the bidder deems most appropriate.

(b) If the proposal calls for unit price items, and the bidder's unit price bid multiplied by the number of units in any item is not equal to the total amount bid for that item, it will be assumed that the unit price bid represents the bidder's intention and an error was made in the multiplication. The Procurement Officer will correct the total amount bid for the item and total sum bid of the bidder's proposal.

(c) If the figure obtained by adding the individual bid items listed in the proposal does not equal to the total figure written in the proposal, it will be assumed that an error was made in the addition and the Procurement Officer will correct the total sum bid.

(d) The bid price shall include all applicable taxes, including the State of Hawaii General Excise Tax, and shall include delivery charges F.O.B. job site.

(e) The bid price shall be firm for a minimum of sixty (60) days from the bid opening date to allow for contract execution.

2.13 Disqualification of Bids. The County may disqualify a bidder and reject its bid for reasons including, but not limited to:

(a) The bidder is non-responsible;

(b) The bid is not responsive;

(c) The bid does not include a listing of subcontractors and joint contractors or contains only a partial or incomplete listing;

(d) The bid is unsigned or is not signed by an authorized representative of the bidder;

(e) Evidence indicating that unit price or lump sum price items are unbalanced in a bid;

(f) Evidence indicating that bidders are in collusion;

(g) Submission of more than one bid whether under the same name or a different name.

Without limiting the generality of the foregoing, a bidder shall be considered to have submitted more than one bid if the bidder submits more than one bid under the bidder's name, through bidder's agents, through joint ventures, partnerships, or corporations or which the bidder has more than twenty-five percent (25%) ownership in each of them, or through any combination of any of them;

(h) The bidder is suspended under Chapter 104 or Chapter 444, HRS;

(i) The bid is not accompanied by an acceptable form of bid security, or the bid security is in an amount less than five percent (5%) of the amount of the base bid, including additives;

(j) The bidder fails to submit a valid and timely certificate of good standing from the Department of Commerce and Consumer Affairs Business Registration Division and/or the bidder fails to submit a valid and timely certificate of compliance from the Department of Labor and Industrial Relations.

(k) The bidder failed to submit the standard form of questionnaire or failed to submit said questionnaire within the due time, when required by the County; or

(l) Evidence of assistance from a person who has been an employee of the County within the preceding two years and who participated while in County office or employment in the matter with which the contract is directly concerned, pursuant to Section 84-15, HRS.

2.14 Bid Security. (a) The County will not consider a bid proposal unless accompanied by bid security in an amount not less than five percent (5%) of the amount bid.

(b) Acceptable bid security shall be limited to the following:

(1) Surety bond underwritten by a company licensed to issue bonds in the State of Hawaii, which shall be substantially in the form provided in the project specifications;

(2) Legal tender;

(3) A certificate of deposit; credit union share certificate; or cashier's, treasurer's, teller's, or official check drawn by, or a certified check accepted by a bank, a savings institution, or credit union insured by the Federal Deposit Insurance Corporation or the National Credit Union Administration, and payable at sight or unconditionally assigned to the County. These instruments may be utilized only to a maximum of \$100,000. If the required security or bond amount totals over \$100,000, more than one instrument not exceeding \$100,000 each and issued by different financial institutions shall be accepted.

(c) The County will return bid security to bidders within ten (10) working days following the execution of the contract by all Parties and after the successful bidder furnishes acceptable performance and payment bonds and certificates of insurances.

2.15 Mandatory Purchase of Hawaii Products. Bidders are instructed to refer to Section 103D-1002, HRS and Chapter 3-124, HAR. Pursuant to HRS 103D-1002(i)(1), requirements related to the mandatory purchase of Hawaii Products shall not apply where doing so would disqualify the County from receiving federal funds or aid. 2 C.F.R. § 200.319(c) specifically prohibits the use of "statutorily or administratively imposed state, local, or tribal geographical preferences in the evaluation of bids or proposals" and as such, the above referenced provisions shall not apply and will not be enforced by the County.

2.16 Substitution of Materials and Equipment. (a) Bids shall be based on materials and equipment specified in the bid documents, unless the Procurement Officer approves substitution of material or equipment by addendum.

(b) A bidder may make a written request for a material or equipment substitution for the Procurement Officer's determination. The written request shall be submitted to the Procurement Officer not less than ten (10) calendar days prior to the day designated for opening of bids. The substitution request shall be accompanied by four (4) copies of any pertinent information for the Procurement Officer's determination. If the Procurement Officer is unable to determine the quality and suitability of the substitution based on the information provided by the bidder, the request shall

be rejected. The burden of proof as to the comparative quality and suitability of the substitution shall be the bidder's responsibility. The Procurement Officer shall be the sole judge as to the comparative quality and suitability of the substitution, and the Procurement Officer's decision shall be final. If the information provided to the Procurement Officer is determined incomplete or insufficient, whereas the Procurement Officer is unable to determine the quality and suitability of the substitution, the request shall be rejected.

(c) If the Procurement Officer approves a material or equipment substitution, an addendum shall be issued by the Procurement Officer.

(d) Bids based on a material or equipment substitution approved by the Procurement Officer, shall include the additional cost required for all modifications, including the cost of revising the construction plans and technical specifications required to accommodate the approved substitution.

2.17 Pre-Opening Modification and Withdrawal of Bids. (a) Bids may be modified prior to the bid submission deadline provided the Procurement Officer receives a written notice stating that a modification to the bid is submitted accompanied by the actual modified bid. The written notice may be faxed pursuant to Subsection 2.19 - Use of Facsimiles, provided the bidder submits the actual written notice and actual modified bid prior to the bid submission deadline and within two (2) working days following the faxed notice.

(b) Bids may be withdrawn provided the Procurement Officer receives a written notice stating the bidder's bid is withdrawn prior to the deadline for opening of bids. The written notice may be faxed pursuant to Subsection 2.19 - Use of Facsimiles. Bids may not be withdrawn after the bid opening.

2.18 Public Opening of Bids. Bids shall be opened publicly in the presence of one or more witnesses, at the time and place designated in the notice to bidders. The amount of each bid and other relevant information, together with the name of each bidder shall be recorded. The record and each bid shall be open to public inspection. [§103D-302, HRS]

2.19 Use of Facsimiles. Copies of documents may be transmitted by bidders via facsimile machine shall be limited to the following:

(a) The request for clarification of bid documents pursuant to Subsection 2.10 - Clarification of Bid Documents;

(b) The request for material or equipment substitution pursuant to Subsection 2.16 - Substitution of Materials and Equipment which includes four (4) copies of any pertinent information; and

(c) The request for modification or withdrawal of bids pursuant to Subsection 2.17 - Pre-Opening Modification and Withdrawal of Bids.

Documents will be received by facsimile machine at the number designated by the County it is the bidder's responsibility to assure the faxed documents are received by the Procurement Officer in a timely matter.

Section 3 – Award and Execution of Contract

3.01 Award of Contract. The award of the contract will be made by written notice by the Officer-in-Charge to the lowest responsive, responsible bidder. Said notice shall not be

construed to be authorization to proceed with the performance of services under the Contract. Any services performed by the Contractor prior to the date indicated in the Notice to Proceed from the Officer-in-Charge shall be at the Contractor's own risk. The contract will be awarded within sixty (60) days after the opening of the bids. If it appears that the contract cannot be awarded within such time, the award may be made after the specified time as mutually agreed upon between the County and the lowest responsive, responsible bidder. The County may cancel the award of the contract at any time before the execution of the contract.

3.02 Execution of Contract. Prior to the drafting of the Contract, discussions may be held between the Parties relative to the extent of the services to be performed by the Contractor and other pertinent matters. The Procurement Officer will submit the contract to the Contractor for review and signature. The Contractor shall enter into a contract with the County and provide sufficient performance and payment bonds and certificates of insurance within ten (10) calendar days after the execution of the contract or within such further time as the County may allow. The contract must be signed in ink by persons duly authorized to enter into contracts with the County. If the Contractor is an individual or partnership, the Contractor shall sign the contract before a notary public. If the Contractor is a corporation, the Contractor shall cause the contract to be signed before a notary public by an officer authorized to do so and shall affix to the contract its corporate seal, together with a certificate, resolution or other instrument vesting such officer with authority to sign the contract on the corporation's behalf. If the Contractor is an association or group, the title or titles of the person or persons signing must be stated and an affidavit which acknowledges the authority of the signer or signers to sign the contract and other necessary documents in connection therewith for the association or group must be attached. The signed contract shall be returned to the Procurement Officer for signature and further processing.

3.03 Performance and Payment Bonds. Within ten (10) calendar days after the execution of the contract or within such further time as the County may allow, the Contractor shall submit sufficient performance and payment bonds for the full and faithful performance of the contract in accordance with the terms and intent thereof and also for the prompt payment to all others for all labor and materials furnished by them to the successful bidder and used in the prosecution of the work provided for in the contract. Performance and payment bonds shall each be in an amount equal to one hundred percent (100%) of the contract price and shall be limited to:

(a) Surety bond underwritten by a company licensed to issue bonds in the State of Hawaii, which shall be substantially in the form provided in the project specifications;

(b) Legal tender; or

(c) A certificate of deposit; credit union share certificate; or cashier's, treasurer's, teller's, or official check drawn by, or a certified check accepted by a bank, a savings institution, or credit union insured by the Federal Deposit Insurance Corporation or the National Credit Union Administration, and payable at sight or unconditionally assigned to the County. These instruments may be utilized only to a maximum of \$100,000. If the required security or bond amount totals over \$100,000, more than one instrument not exceeding \$100,000 each and issued by different financial institutions shall be accepted.

3.04 Tax Clearance Requirement. Pursuant to §103D-328, HRS, the Contractor shall submit a tax clearance certificate issued by the Hawaii State Department of Taxation ("DOTAX") and the Internal Revenue Service ("IRS"). The certificate shall be valid for six (6) months from the most recent approval stamp date on the certificate and must be valid on the date it is received by the County. The application for the tax clearance shall be the responsibility of the Contractor, and must be submitted directly to the DOTAX or IRS and not to the County.

3.05 Hawaii Business Requirement. The Contractor shall comply with either §103D-310(c)(1) or §103D-310(c)(2), HRS, as follows:

(a) §103D-310(c)(1), HRS, Hawaii business. A business entity meeting the requirement of §103D-310(c)(1), HRS, referred to as a “Hawaii business”, is incorporated or organized under the laws of the State of Hawaii. As evidence of compliance, the Contractor shall submit a “Certificate of Good Standing” issued by the Department of Commerce and Consumer Affairs Business Registration Division (BREG). A Hawaii business that is a sole proprietorship, however, is not required to register with the BREG, and therefore not required to submit the certificate. A Contractor's status as a sole proprietor and its business street address indicated in Contractor's bid will be used to confirm that the Contractor is a Hawaii business.

(b) §103D-310(c)(2), HRS, Compliant non-Hawaii business. A business entity meeting the requirement of §103D-310(c)(2), HRS, referred to as a “compliant non-Hawaii business,” is not incorporated or organized under the laws of the State of Hawaii but is registered to do business in the State as a separate branch or division capable of fully performing under the contract. As evidence of compliance, the Contractor shall submit a “Certificate of Good Standing” issued by the BREG.

(c) The above certificates shall be current within six (6) months of issuance date and submitted to the County prior to award of contract. If a valid certificate is not submitted on a timely basis for award of a contract, a bid otherwise responsive and responsible may not receive the award. The application for the above certificates shall be the responsibility of the Contractor, and must be submitted directly to the BREG and not to the County.

3.06 Department of Labor and Industrial Relations. (a) The Contractor shall submit a certificate of compliance (DLIR Form LIR #27), issued by the DLIR stating the Contractor complies with Chapters 383, 386, 392, and 393 of the Hawaii Revised Statutes

(b) The above certificate shall be current within six (6) months of issuance date and submitted to the County prior to award of contract. If a valid certificate is not submitted on a timely basis for award of a contract, a bid otherwise responsive and responsible may not receive the award. The application for the above certificates shall be the responsibility of the Contractor, and must be submitted directly to the DLIR and not to the County.

3.07 Contract Not Binding Unless Properly Executed and Appropriation Available. The contract shall not be binding or of any force until said contract has been fully and properly signed by all of the Parties thereto and approved by the Procurement Officer as to availability of funds in the amount and for the purpose set forth therein. The Contractor's execution of the contract shall be considered verification that the Contractor has reviewed, understands, accepts, and agrees to abide by the terms and conditions contained in the bid documents, the proposal submitted by the Contractor, the proposed contract, and the performance and payment bonds.

3.08 Forfeiture of Bid Security. Failure to execute the contract and furnish sufficient performance and payment bonds shall be cause for the cancellation of award to the Contractor. The Contractor also forfeits the bid security which becomes the property of the County, which is not a penalty, but liquidated damages sustained by the County. The County may make award to the next lowest responsive, responsible bidder or the County may re-advertise the work contemplated.

Section 4 – Legal Relations and Responsibilities

4.01 Independent Contractor. The Contractor shall perform the contract as an independent contractor and shall not be entitled to any benefits and privileges of an employee of the County of Maui for purposes including, but not limited to, the County's civil service system, fringe benefits, unemployment benefits, worker's compensation benefits, federal and state taxes, social security tax, medicare tax, FICA tax and any other employment taxes. Upon execution of the contract, the Contractor shall comply with Chapter 237 (general excise tax); Chapter 383 (employment security); Chapter 386 (workers' compensation); Chapter 392 (temporary disability insurance); and Chapter 393 (pre-paid health care), HRS. The Contractor and Contractor's sureties shall be liable for any loss caused to the County by reason of the Contractor's failure to comply with Chapter 386, HRS.

4.02 Contractor's Inability to Contract for County. Notwithstanding anything herein contained to the contrary, Contractor shall not have the right to make any contracts or commitments for, or on behalf of, the County without first obtaining written consent of the County.

4.03 Insurance. (a) The Contractor shall submit to the Officer-in-Charge within ten (10) calendar days after execution of the contract, or within such further time as the County may allow, three (3) copies of insurance certification evidencing that the Contractor has in force the following types of insurance with the following minimum limits of liability:

- (1) HRS Chapters 383 (Unemployment Insurance), 386 (Workers' Compensation), 392 (Temporary Disability Insurance), and 393 (Prepaid Health Care) requirements for award. The Contractor shall submit an approved certificate of compliance issued by the Hawaii State Department of Labor and Industrial Relations (DLIR). The certificate shall be valid for six (6) months from the date of issue and must be valid on the date it is received by the County. The application for the certificate shall be the responsibility of the Contractor, and must be submitted directly to the DLIR and not to the County. [§103D-310(c), HRS]
- (2) Employers' Liability Insurance. The Contractor and anyone acting under its direction or control or on its behalf shall at its own expense procure and maintain and require the Contractor's sub-contractors (if any) at their own expense to procure and maintain in full force at all times during the term of this Contract, employers' Liability insurance with minimum limits for bodily injury from accident of FIVE HUNDRED THOUSAND DOLLARS (\$500,000), or such other limit acceptable to the County, - each accident; for bodily injury from disease of FIVE HUNDRED THOUSAND DOLLARS (\$500,000), or such other limit acceptable to the County, - each employee; and for bodily injury from disease of FIVE HUNDRED THOUSAND DOLLARS (\$500,000), or such other limit acceptable to the County, - each policy limit.
- (3) Commercial General Liability Insurance. The Contractor and anyone acting under its direction or control or on its behalf shall at its own expense procure and maintain and require the Contractor's sub-contractors (if any) at their own expense to procure and maintain in full force at all times during the terms of this Contract, Commercial General Liability insurance with a bodily injury and property damage combined single limit of liability of at least ONE MILLION DOLLARS (\$1,000,000), for any occurrence, and THREE MILLION DOLLARS (\$3,000,000) in the aggregate, or such other limit acceptable to the County. Such insurance shall include coverage in like amount for products/completed operations, contractual liability, and personal

and advertising injury. "Claims made" policies are not acceptable under this Section.

- (4) Automobile Liability Insurance. The Contractor and anyone acting under its direction or control or on its behalf shall at its own expense procure and maintain and require the Contractor's sub-contractors (if any) at their own expense to procure and maintain in full effect at all times during the term of this Contract, Automobile Liability insurance with a bodily injury and property damage combined single limit of at least ONE MILLION DOLLARS (\$1,000,000), or such other limit acceptable to the County, per accident.
- (5) Fire and Standard Extended Coverage Insurance. Except for contracts in which the scope of work is limited to roadway construction or utility improvements that do not include payment for stored materials on-site, the Contractor shall insure the work for one million dollars (\$1,000,000), or such other limit acceptable to the County, plus one hundred percent (100%) of the replaceable value thereof for the life of the contract against all loss or damage by fire at the site and against all loss or damage covered by the Standard Extended Coverage Insurance endorsement, including vandalism and malicious mischief, by an insurance company or companies acceptable to the County. The amount of insurance may vary with the extent of the work complete, but shall at all times be at least equal to one million dollars (\$1,000,000), or such other limit acceptable to the County, plus the replaceable value of the amount paid for the work and materials installed and delivered, plus the replaceable value of the work or materials furnished or delivered by the Contractor but not yet paid for by the County. The insurance policy or policies shall be held jointly in the name of the County, the Contractor, and the Contractor's subcontractors as their interest may appear. The Contractor shall submit to the County satisfactory proof of the amount of such insurance carried with each application for partial payment.
- (6) County as Additional Insured. Insurance policies providing the insurance coverage required in this Section (except for Workers' Compensation) shall name the County, its agents, and its employees as additional insured for any claims arising from the Contractor's activities under this Contract. Coverage must be primary in respect to the additional insured. Any other insurance carried by the County shall be excess only and not contribute with this insurance. Such policies or certificates showing the above coverage shall be deposited with the County within ten (10) days of the execution of this Contract and shall contain the following statement:

"The Named Insured, its Insurance Carrier or Broker shall notify the certificate holder of any cancellation, or reduction in coverage or limits, of any insurance within thirty (30) days of receipt of insurers' notification to that effect."

(b) When a subcontractor is utilized, the Contractor shall furnish or require the subcontractor to furnish the Procurement Officer within ten (10) calendar days after execution of the contract, or within such further time as the County may allow, with a copy of a policy or policies of insurance and certificate of insurance covering the subcontractor and the subcontractor's employees or agents in the same amount and for the same liability specified above.

(c). In the event of cancellation or termination of any policy required above or any substitute policy as provided for hereinafter, the Contractor or the subcontractor, as the case may be, shall immediately furnish the Procurement Officer with a substitute policy of insurance in the same amount and for the same liability specified above.

4.04 Indemnification. The Contractor shall defend, indemnify and hold harmless the County and its officers and employees harmless from any and all deaths, injuries, losses and damages to persons or property, and any and all claims, demands, suits, action and liability therefor, caused by error, omissions, or negligence in the performance of the contract by the Contractor or Contractor's subcontractors, agents and employees. The Contractor's obligations under this Section shall survive and shall continue to be binding upon Contractor notwithstanding the expiration, termination or surrender of the contract.

4.05 Absence of Interest. The Contractor covenants that it currently has no interest and shall not acquire any interest, direct or indirect, which would conflict in any manner or degree with the performance of services required to be performed under the contract. The Contractor further covenants that in the performance of the contract, no person having such interest shall be employed.

4.06 Laws and Regulation. (a) The Contractor shall keep fully informed of all applicable federal, state, and county laws, ordinances, codes, rules and regulations, governmental general and development plans and all changes thereto including, but not limited to, the Americans with Disabilities Act, health and safety, labor, anti-discrimination and environmental laws and regulations, and the following:

- (1) All Sections of the local County's Charter and Code;
- (2) Article I of Title 10, Maui County Code, 1980, as amended, relating to the Maui Traffic Code;
- (3) Title 12, Maui County Code, 1980, as amended, relating to Streets, Sidewalks, and Public Places;
- (4) Chapter 16.04C, Maui County Code, 1980, as amended, relating to the Fire Code;
- (5) Chapter 16.18B, Maui County Code, 1980, as amended, relating to the Electrical Code;
- (6) Chapter 16.20B, Maui County Code, 1980, as amended, relating to the Plumbing Code;
- (7) Chapters 103 and 103D, HRS, as amended, relating to Expenditure of Public Money and Public Contracts and the Hawaii Public Procurement Code, including Hawaii Administrative Rules Chapter 103D (Chapters 3-120, 3-121, 3-122, 3-123, 3-124, 3-125, 3-126, 3-128, 3-129, 3-130, 3-131, 3-132);
- (8) Chapter 104, HRS, as amended, relating to Wages and Hours of Employees on Public Works;
- (9) Chapter 22 of Subtitle 4 of Title 12, HAR, relating to Wage Determinations and the Administration and Enforcement of Chapter 104, HRS;
- (10) Chapter 132, HRS, as amended, relating to the Fire Protection;
- (11) Chapter 321, HRS, as amended, relating to the Department of Health;
- (12) Chapter 378, HRS, as amended, relating to Fair Employment Practices;
- (13) Chapter 386, HRS, as amended, relating to Workers' Compensation Law;

- (14) Chapter 396, HRS, as amended, relating to Occupational Safety and Health, and specifically, all bids and proposals in excess of \$100,000 for construction jobs shall have a signed certification from the bidder or offeror that a written safety and health plan for the job will be available and implemented by the notice to proceed date of the project (see §396-18, HRS);
- (15) Chapter 444, HRS, as amended, relating to contractors for construction work. Provider shall use properly licensed contractors for all construction work as required by law;
- (16) Part III of Subtitle 8 of Title 12, HAR, relating to Construction Standards; and
- (17) Chapters 120 to 132 of Subtitle 11 of Title 3, HAR, relating to the Hawaii Public Procurement Code.

(b) The Contractor shall comply with all such laws, ordinances, codes, rules, regulations, design standards and criteria, governmental general and development plans. If any discrepancy or inconsistency is discovered between the contract and any such law, ordinance, code, rule, regulation, design standard, design criterion, and governmental general and development plans, the Contractor shall immediately report the same in writing to the Officer-in-Charge.

(c). The Contractor shall obtain all necessary permits and approvals for the performance of the contract and shall pay for all charges in connection with such permits.

Section 5 – County Responsibility

5.01 Cooperation by the County. The County, through the Officer-in-Charge, shall cooperate fully with the Contractor and will promptly place at the disposal of the Contractor all available pertinent information which the County may have in its possession. The Officer-in-Charge will certify to the accuracy of certain information in writing whenever it is possible to do so. The County does not represent that other information not certified as accurate is so and takes no responsibility therefor, and the Contractor shall rely on such information at the Contractor's own risk.

5.02 Review by the County. The Officer-in-Charge shall review all submissions and other work and data required to be made by the Contractor and reject or approve such submissions in their entirety or approve the same subject to such deletions, additions and revisions as the County may deem necessary and proper. For submissions specified in the special provisions, all items not required by the County to be deleted, added or revised after review by the Officer-in-Charge and not defective by reason or error, omissions or negligence on the part of the Contractor, subcontractors, agents or employers shall be deemed to have been approved.

5.03 Limitation of Liability. The County shall be responsible for damage or injury caused by the County's agents, officers, and employees in the course of their employment to the extent that the County's liability for such damage or injury has been determined by a court or otherwise agreed to by the County, and the County shall pay for such damage or injury to the extent permitted by law and approved by the Maui County Council. The County's total liability under the contract, if any, is strictly limited to the provisions in this Paragraph.

Section 6 – Performance of Contract

6.01 Time. (a) Time is of the essence herein. Performance of the services under the contract shall commence on the commencement date designated in the Notice to Proceed and the services described herein shall be completed within the time specified.

(b) If the Contractor cannot complete the contract within the time specified due to reasons beyond its control, a written request for a time extension accompanied by a detailed accounting of the causes and reasons for such delays may be submitted to the Officer-in-Charge for determination as to whether a time extension will be granted. The Officer-in-Charge's decision shall be final.

(c) If the scope of the work is amended during construction, an appropriate adjustment may be made to the contract time subject to approval by the Officer-in-Charge.

(d) Any adjustment to the contract time shall be made by contract amendment or change order.

6.02 Preconstruction Meeting. The County may schedule a pre-construction meeting after the execution of the contract.

6.03 Construction Schedule. (a) The Contractor shall submit to the Officer-in-Charge a detailed construction schedule in critical path method (“CPM”) format, itemizing the various subdivisions of work and their durations at the pre-construction meeting, if held. If a pre-construction meeting is not held, the Contractor shall submit the schedule to the Officer-in-Charge not more than ten (10) calendar days after the Notice to Proceed is issued.

(b) The detailed construction schedule shall include: construction activities, the submission and approval of samples of materials and shop drawings, the procurement of materials and equipment, fabrication of materials and equipment and their delivery, installation, and testing, and start-up in CPM format.

(c) The Contractor shall revise the construction schedule whenever any delays are anticipated in any of the various items of work, or the performance of such items of work are obviously not in accordance with the construction schedule, and submit it to the Officer-in-Charge, together with the reasons for such anticipated or actual delays, and the planned courses of action to prevent or minimize any delay in the completion of the contract. Acceptance of the revised construction schedule and the reasons for such revisions shall not be construed to mean concurrence or acceptance as a basis for any time extension by the Officer-in-Charge.

6.04 Construction Progress. (a) The Contractor shall furnish such manpower, materials, facilities and equipment as may be necessary to insure the prosecution and completion of the work in accordance with the accepted schedule. If work falls fourteen (14) days or more behind the accepted construction schedule, the Contractor agrees to take some or all of the following actions to return the project to the accepted schedule. These actions may include the following:

- (1) Increase manpower in quantities and crafts;
- (2) Increase the number of working hours per shift, shifts per working day, working days per week, or the amount of equipment, or any combination of the foregoing; and/or

(3) Reschedule activities.

(b) Upon demand by the Officer-in-Charge, the Contractor shall prepare a proposed construction schedule revision demonstrating a plan to make up the lag in progress and insure completion of the work within the contract time. Upon receipt of an acceptable proposed schedule, the revision to the construction schedule shall be included a change order to the contract in accordance with Section 8 – Contract Amendments/Change Orders.

(c) All actions to return the project to the accepted schedule are at the Contractor's sole expense. The Contractor shall pay all costs incurred by the County which result from the Contractor's action to return the project to its accepted schedule. Contractor agrees that County shall deduct such charges from payments due the Contractor. It is further understood and agreed that none of the services performed by the Officer-in-Charge in monitoring, reviewing and reporting project status and progress shall relieve the Contractor of responsibility for planning and managing construction work in conformance with the construction schedule.

(d) When the Contractor foresees a delay in the prosecution of the work and, in any event, immediately upon the occurrence of a delay which the Contractor regards as unavoidable, the Contractor shall notify the Officer-in-Charge in writing of the probability of the occurrence of such delay, the extent of the delay, and its possible cause. The Contractor shall take immediate steps to prevent, if possible, the occurrence or continuance of the delay. If this cannot be done, the Officer-in-Charge shall determine how long the delay shall continue, to what extent the prosecution and completion of the work are being delayed thereby, and whether the delay is to be considered avoidable or unavoidable. The Officer-in-Charge shall notify the Contractor of the Officer-in-Charge's determination. The Contractor agrees that no claim shall be made for delays which are not called to the attention of the Officer-in-Charge at the time of occurrence.

(e) In case the work is not completed in the time specified, including extension of time as may have been granted for unavoidable delays, the Contractor shall be assessed damages for those costs incurred by the County which are attributable to the fact that the work was not completed on schedule.

6.05 Avoidable Delays. (a) Avoidable delays in the prosecution of the work shall include delays which could have been avoided by the exercise of care, prudence, foresight and diligence on the part of the Contractor or its subcontractors. Avoidable delays include:

- (1) Delays which may in themselves be unavoidable but which affect only a portion of the work and do not necessarily prevent or delay the prosecution of other parts of the work nor the completion of the whole work within the contract time.
- (2) Time associated with the reasonable interference of other contractors employed by the County which do not necessarily prevent the completion of the whole work within the contract time.

(b). The County may grant an extension of time for avoidable delay if deemed in the County's best interest. If the County grants an extension of time for avoidable delay, the Contractor agrees to pay actual costs, including charges for construction management, engineering and administration incurred during the extension, and other damages incurred by the County. Such time extension shall be included in the contract as a change order pursuant to Section 8 – Contract Amendments/Change Orders.

6.06 Unavoidable Delays. (a) Unavoidable delays in the prosecution or completion of the work shall include delays which result from causes beyond the control of the Contractor and which could not have been avoided by the exercise of care, prudence, foresight and diligence on

the part of the Contractor or its subcontractors. Delays in completion of the work of other contractors employed by the County will be considered unavoidable delays insofar as they interfere with the Contractor's completion of the work. Delays due to normal weather conditions shall not be regarded as unavoidable as the Contractor agrees to plan work with prudent allowances for interference by normal weather conditions. Delays caused by fire, unusual storms, floods, tidal waves, earthquakes, strikes, labor disputes, freight embargoes and shortages of materials shall be considered as unavoidable delays insofar as they prevent the Contractor from proceeding with at least seventy-five percent (75%) of the normal labor and equipment force for at least four (4) hours per day toward completion of the current controlling item on the accepted critical path schedule.

(b) Should unavoidable delays prevent the work from beginning at the usual starting time, or prevent the Contractor from proceeding with seventy-five percent (75%) of the normal labor and equipment force for a period of at least four (4) hours per day, and the crew is dismissed as a result thereof, the Contractor will not be charged for a working day whether or not conditions change so that the major portion of the day could be considered to be suitable for work on the controlling item.

(c) For delays which the Contractor considers to be unavoidable, the Contractor shall submit to the Officer-in-Charge complete information demonstrating the effect of the delay on the critical path in the construction schedule. The submission shall be made within thirty (30) calendar days of the occurrence which is claimed to be responsible for the unavoidable delay. The Officer-in-Charge shall review the Contractor's submission and determine the number of days of unavoidable delay and the effect of such unavoidable delay on the critical path of the work. The County agrees to grant an extension of time, but no monetary compensation, to the extent that unavoidable delays affect the critical path in the construction schedule. During such extension of time, neither extra compensation or engineering inspection and administration nor damages for delay will be charged to the Contractor. It is understood and agreed by the Contractor and County that time extensions due to unavoidable delays will be granted only if such unavoidable delay involve critical activities which would prevent completion of the whole work within the specified contract time.

6.07 Furnishing of Plans and Specifications. The County will furnish the Contractor with up to six (6) sets of the plans and specifications at no cost to the Contractor. The Contractor shall be responsible for the cost of printing any additional plans and specifications.

6.08 Breakdown of Lump Sum Items. If the bid form calls for a total sum bid without bid items, or contains lump sum items, the Contractor shall submit a detailed cost breakdown of the total sum bid or such lump sum items not less than twenty (20) calendar days following issuance of Notice to Proceed.

6.09 Commencement of Work. The Contractor shall not commence with any work prior to the effective date of the Notice to Proceed.

6.10 Prosecution of Work. The Contractor shall be available upon reasonable demand to discuss the progress of the services being performed under the contract. All questions arising during the performance of the contract which must be resolved by the Procurement Officer or Officer-in-Charge shall be brought to their immediate attention by Contractor.

6.11 Contractor to Report Errors or Discrepancies. Should the Contractor discover any apparent inconsistencies within the contract documents, discrepancies between the contract documents and the conditions on the ground, or any error or omission in the contract documents or instructions, the Contractor shall immediately advise the Officer-in-Charge in writing thereof. If, after discovery, the Contractor elects to perform any work which may require revisions without

authorization by the Officer-in-Charge, such work shall be performed solely at the Contractor's risk.

6.12 Authority of the Procurement Officer and Officer-in-Charge. Any question or dispute concerning any provision of the contract which may arise during its performance shall be decided by the Officer-in-Charge. The decisions of the Officer-in-Charge shall be final and binding upon all Parties unless the same is fraudulent, capricious, arbitrary, or so grossly erroneous as necessarily to imply bad faith or is not supported by substantial evidence, provided that decisions on questions or disputes relating to acceptance of the services performed under the contract, suspension or termination of the contract, extension of time, reduction or increase in the compensation of the Contractor and payment shall become final and binding upon all Parties only upon approval of the Procurement Officer, and provided further that nothing herein shall be construed as making final and binding any decision of the Officer-in-Charge and/or Procurement Officer on a question of law. Pending final decision of any dispute or question, the Contractor shall proceed diligently with the performance of services under the contract in accordance with the decision of the Officer-in-Charge and/or Procurement Officer.

6.13 Subcontracting. (a) The Contractor shall not subcontract any part of the contract except to those subcontractors specifically listed in the proposal submitted by the Contractor; provided that the Contractor may, for good cause, engage other subcontractors with the Officer-in-Charge's approval.

(b) Subcontractors and their employees shall be considered employees of the Contractor. Engaging subcontractors to perform any work shall not relieve the Contractor of its duty to complete the work in accordance with the contract.

(c) The Contractor shall replace any subcontractor for not performing in accordance with the contract when required and so notified by the Officer-in-Charge.

6.14 Rate of Wages for Laborers and Mechanics. (a) Every laborer and mechanic performing work on the job site for the construction of the work shall be paid no less than the prevailing wages provided that:

- (1) Prevailing wages shall be not less than the wages that the Director of Labor and Industrial Relations, shall have determined to be the prevailing wages for corresponding classes of laborers and mechanics on projects of similar character in the State;
- (2) The prevailing wages shall be not less than the wages payable under federal law to corresponding classes of laborers and mechanics employed on public works in the State that are prosecuted under contract or agreement with the government of the United States; and
- (3) Notwithstanding the provisions of the contract, the prevailing wages shall be periodically adjusted during the performance of the contract in an amount equal to the change in the prevailing wages as periodically determined by the Director of Labor and Industrial Relations. [§104-2(b), HRS]

(b) No laborer or mechanic employed on the job site of any public work of the County thereof shall be permitted or required to work on Saturday, Sunday, or a legal holiday of the State or in excess of eight hours on any other day unless the laborer or mechanic receives overtime compensation for all hours worked on Saturday, Sunday, and a legal holiday of the State or in excess of eight hours on any other day. For purposes of determining overtime compensation under this Subsection, the basic hourly rate of any laborer or mechanic shall not be less than the basic

hourly rate determined by the Director of Labor and Industrial Relations to be the prevailing basic hourly rate for corresponding classes of laborers and mechanics on projects of similar character in the State. [§104-2(c), HRS]

(c) The Contractor or the Contractor's subcontractors shall pay all mechanics and laborers employed on the job site, unconditionally and not less often than once a week, and without deduction or rebate on any account, except as allowed by law, the full amounts of their wages including overtime, accrued to not more than five (5) working days prior to the time of payment, at wage rates not less than those deemed to be prevailing, regardless of any contractual relationship which may be alleged to exist between the Contractor or subcontractor and the laborers and mechanics.

(d) The rates and wages to be paid shall be posted by the Contractor in a prominent and easily accessible place at the job site, and a copy of the rates of wages required to be posted shall be given to each laborer and mechanic employed under the contract by the Contractor at the time each laborer and mechanic is employed, except that where there is a collective bargaining agreement the Contractor does not have to provide the Contractor's employees the wage rate schedules. [§104-2(d), HRS]

(e) The Contractor shall be solely responsible for any increase in rates and wages during the contract.

(f) The County may withhold from the Contractor so much of the accrued payments as the County may consider necessary to pay to the laborers and mechanics employed by the Contractor or any subcontractor on the job site the difference between the prevailing wages and the wages received and not refunded by the laborers and mechanics. [§104-2(e), HRS]

6.15 Payrolls and Payroll Records. (a) A certified copy of all payrolls shall be submitted weekly to the Officer-in-charge for review. The Contractor shall be responsible for the submission of certified copies of the payrolls of all subcontractors. The certification shall affirm that the payrolls are correct and complete, that the wage rates contained therein are not less than the prevailing wages and the classifications set forth for each laborer or mechanic conform with the work the laborer or mechanic performed. Any certification discrepancy found by the County shall be reported to the Contractor and Director of Labor and Industrial Relations. [§104-3(a), HRS]

(b) Payroll records for all laborers and mechanics working at the site of the work shall be maintained by the Contractor and the Contractor's subcontractors during the course of the work and preserved for a period of three (3) years thereafter. The records shall contain the name of each employee, the employees' correct classification, rate of pay, daily and weekly number of hours worked, deductions made and actual wages paid. [§104-3(b), HRS]

(c) The Contractor shall make payroll records available for examination within ten (10) calendar days from the date of the written request by the County, Director of Labor and Industrial Relations of the State, or any authorized representatives thereof. Any Contractor who:

- (1) Fails to make payroll records accessible within ten (10) calendar days;
- (2) Fails to provide information requested for the proper enforcement of Chapter 104-3, HRS, within ten (10) calendar days; or
- (3) Fails to keep or falsifies any record required under Chapter 104-3, HRS, shall be assessed a penalty as set forth in Section 104-22(b), HRS. [§104-3(c), HRS]

6.16 Prompt Payment by Contractor to Subcontractors and Vendors. (a) Any money, other than compensation retained, paid to the Contractor shall be dispersed to subcontractors and vendors within ten (10) calendar days after receipt of the money in accordance with the terms of the subcontract; provided that the subcontractor met all the terms and conditions of the subcontract and there are no bona fide disputes on which the County has withheld payment. [§103-10.5(a), HRS]

(b) Upon final payment to the Contractor, full payment to the subcontractor, including compensation retained, shall be made within ten (10) calendar days after receipt of money, provided that there are no bona fide disputes over the subcontractor's performance under the subcontract. [§103-10.5(b), HRS]

(c) Where a subcontractor has provided evidence to the Contractor of satisfactorily completing all work under their subcontract and has provided a properly documented final payment request as described in (b) above, and:

(1) Has provided the Contractor an acceptable performance and payment bond for the work under the contract executed by a surety company authorized to do business in the State of Hawaii, as provided in Section 103-32.1, HRS; or

(2) The following has occurred:

(A) A period of ninety (90) days) after the day on which the last of the labor was done or performed and the last of the material was furnished or supplied has elapsed without written notice of a claim given to Contractor or surety, as provided in Section 103D-324, HRS; and

(B) The subcontractor has provided to the Contractor:

(i) An acceptable release of retainage bond, executed by a surety company authorized to do business in the State, in an amount of not more than two times the amount being retained or withheld by the Contractor;

(ii) Any other bond acceptable to the Contractor; or

(iii) Any other form of mutually acceptable collateral, all sums retained or withheld from a subcontractor and otherwise due to the subcontractor for satisfactory performance under the subcontract shall be paid by the Procurement Officer to the Contractor and subsequently, upon receipt from the Procurement Officer, by the Contractor to the subcontractor within the applicable time periods specified in Subsection (b) and Section 103-10. If the Procurement Officer or the Contractor fails to pay in accordance with this Section, a penalty of one and one-half percent per month shall be imposed upon the outstanding amounts due that were not timely paid by the responsible party. The penalty may be withheld from future payment due to the Contractor, if the Contractor was the responsible party. If a contractor has violated Subsection (b) three or more times within two years of the first violation, the Contractor shall be referred by the Procurement Officer to the Contractor license board for action under Section 444-17(14), HRS.

(d) A properly documented final payment request from a subcontractor, as required by Subsection (c), shall include:

(1) Substantiation of the amounts requested;

- (2) A certification by the subcontractor, to the best of the subcontractor's knowledge and belief, that:
- (A) The amounts requested are only for performance in accordance with the specifications, terms, and conditions of the subcontract;
 - (B) The subcontractor has made payments due to its subcontractors and suppliers from previous payments received under the subcontract and will make timely payments from the proceeds of the payment covered by the certification, in accordance with their subcontract agreements and the requirements of this Section; and
 - (C) The payment request does not include any amounts that the subcontractor intends to withhold or retain from a subcontractor or supplier in accordance with the terms and conditions of their subcontract; and
- (3) The submission of documentation confirming that all other terms and conditions required under the subcontract agreement have been fully satisfied.

The Procurement Officer shall return any final payment request that is defective to the Contractor within seven days after receipt, with a statement identifying the defect.

- (e) In the case of a construction contract, a payment request made by a contractor to the Procurement Officer that includes a request for sums that were withheld or retained from a subcontractor and are due to a subcontractor may not be approved under Subsection (c) unless the payment request includes:
- (1) Substantiation of the amounts requested; and
 - (2) A certification by the Contractor, to the best of the Contractor's knowledge and belief, that:
- (A) The amounts requested are only for performance in accordance with the specifications, terms, and conditions of the contract;
 - (B) The subcontractor has made payments due to its subcontractors and suppliers from previous payments received under the contract and will make timely payments from the proceeds of the payment covered by the certification, in accordance with their subcontract agreements and the requirements of this Section; and
 - (C) The payment request does not include any amounts that the Contractor intends to withhold or retain from a subcontractor or supplier in accordance with the terms and conditions of their subcontract.
- (f) This Section shall not be construed to impair the right of a contractor or a subcontractor at any tier to negotiate and to include in their respective subcontracts provisions that provide for additional terms and conditions that are requested to be met before the subcontractor shall be entitled to receive final payment under Subsection (c) of this Section; provided that any such payments withheld shall be withheld by the Procurement Officer.

6.17 Termination of Work on Failure to Pay Agreed Wages. If the County finds that any laborer or mechanic employed on the job site by the Contractor or any subcontractor has been or is being paid wages at a rate less than the required rate by the contract or specifications, or has not received the laborer's or mechanic's full overtime compensation, the County may, by written

notice to the Contractor, terminate the Contractor's right, or the right of any subcontractor, to proceed with the work or with the part of the work in which the required wages or overtime compensation have not been paid and may complete such work or part by contract or otherwise, and the Contractor and the Contractor's sureties shall be liable to the County for any excess costs occasioned thereby. [§104-4, HRS]

6.18 Vehicular and Pedestrian Traffic, Public Convenience, and Safety. (a) If the project requires the closing or obstruction of any public thoroughfare, the Contractor shall comply with the Manual on Uniform Traffic Control Devices, U. S. Department of Transportation, Federal Highway Administration, and the Maui Traffic Code of the Maui County Code, 1980, as amended.

(b) No pedestrian or vehicular traffic within public rights of way shall be altered without authorization from the Hawaii State Department of Transportation, Department of Public Works, Police Department, and Department of Fire and Public Safety.

(c) The Contractor shall minimize, to the extent possible, hazardous conditions; shall provide additional safety devices as deemed prudent; shall maintain all signs, signals, lighting devices, markings, and barricades provided to minimize public inconvenience; and shall exercise safety practices during all hours of the day for as long as such hazardous conditions exist. The Contractor shall prudently extend applicable provision of this Subsection to areas, other than streets and highways, which involve the project.

(d) The presence of inspectors on the project or their oversight to discover or to point out any noncompliance on the part of the Contractor shall not relieve the Contractor from its responsibility under this Subsection.

6.19 Work on Weekends and Holidays, Night Work, and Overtime Work. (a) No work, except for resolution of an emergency event, shall be performed on Saturdays, Sundays, or State/County recognized legal holidays, unless authorized by the Officer-in-Charge.

(b) No work shall be performed between sunset and sunrise, unless required by the contract documents or authorized by the Officer-in-Charge.

(c) No work in excess of eight (8) hours per day or in excess of forty (40) hours per week shall be performed unless authorized by the Officer-in-Charge.

(d) The Contractor shall be responsible for costs incurred by the County under Paragraphs (a), (b), and (c).

6.20 Value Engineering. (a) Except with specific approval from the Officer-in-Charge, this Subsection shall be applicable only if the contract price is in excess of \$100,000 and will result in a net savings in the project of at least \$1,000.

(b) Any cost reduction proposal intended to be considered as a value engineering change proposal (VECP) shall be so identified as a value engineering change proposal and submitted to the Officer-in-Charge.

(c) In order that any proposal be accepted as a VECP, it must result in a net cost savings to the County by providing a system, structure, procedure or process better than the design specified or by providing less costly items than those specified in the contract documents without impairing any of their essential functions and characteristics such as service life, reliability, economy of operation, ease of maintenance, and necessary standardized features. [§103-49, HRS]

(d) With the submission of any VECP, the Contractor shall submit the following information:

- (1) A description of the difference between the existing contract requirements and the VECP, and the comparative advantages and disadvantages of each;
- (2) An itemization of the requirements of the contract which must be changed if the VECP is accepted and recommendations as to how each change should be made;
- (3) An estimate of the reduction in construction costs or the net cost savings to the County that would result from acceptance of the VECP, taking into account the costs of implementation by the Contractor, including costs attributable to subcontractors, and the basis of the estimate;
- (4) A prediction of effects the VECP would have on other costs to the County, such as County-furnished property costs, costs of related items, and costs of maintenance and operations;
- (5) A statement of the time by which a change order accepting the VECP should be issued to obtain the maximum cost reduction during the remainder of the contract period, noting any effect on the contract period; and
- (6) The dates of any previous submissions of the value engineering change proposals, the number of any governmental contracts under which submitted and the previous actions by the various branches of government.

(e) The submission of any VECP by the Contractor and the receipt thereof by the Officer-in-Charge, or verbal acceptance of any VECP by any employee, assign, or agent of the County shall not obligate the County to accept or approve any such proposal. The Contractor shall comply with the provisions of the contract until such time that a VECP is approved.

(f) The County may accept in whole or in part any VECP. Its decision in the acceptance of any VECP is final. The County will approve value engineering change proposals by issuing change orders.

(g) The Contractor may restrict the County's right to use any sheet of a value engineering change proposal or of the supporting data in accordance with the terms of the following legend if it is marked as follows on such the sheet:

"This data furnished pursuant to a value engineering incentive clause shall not be duplicated, used, or disclosed, in whole or in part, for any purpose other than to evaluate a value engineering change proposal submitted under said clause. This restriction does not limit the County's right to use information contained in this data if it is or has been obtained from another source, or is otherwise available, without limitations. If after use of the data in evaluating a value engineering change proposal, the County accepts the proposal by issuing a change order, the County shall have the right to duplicate, use, and disclose any data pertinent to the proposal as accepted, in any manner and for any purpose whatsoever, and authorize others to do likewise."

(h) If the VECP is approved, the Contractor grants to the County all rights to use, duplicate or disclose in whole or part, in any manner and for any purpose, and to have or permit others to do likewise, any data reasonably necessary to fully utilize such a proposal. Contract modifications made as a result of this clause will state that they are made pursuant to it.

(i) If a VECP is accepted, affected portions of the construction plans and specifications shall be modified by change order.

(j) An equitable adjustment shall be made in the contract price so that the Contractor will share a portion of the realized cost reduction.

(k) If a VECP is accepted, an adjustment shall be made to the contract time, as required.

(l) Previously accepted or previously submitted but not accepted value engineering change proposals under other contracts, or both, may be submitted for consideration; provided that previously accepted value engineering change proposals under other contracts shall not be grounds for automatic acceptance under the contract.

(m) The County may impose, as a condition of acceptance of any VECP, a requirement that the Contractor warrants the statements, claims, and other information contained in the VECP regarding essential functions and characteristics such as service life, reliability, economy of operation, ease of maintenance, and desired appearance, such warranty to be for an appropriate period to be determined by the County.

(n) The determination of the proposed VECP shall be at the County's sole discretion and the decision will be final.

(o) The County shall not be liable for costs or delays incurred by the Contractor regarding the County's determination with respect to a proposed VECP including development costs, anticipated profits, and increased material or labor costs. Non-conforming work and the annulment of VECP review shall not be the basis of claim against the County including claims for delay.

6.21 Plans to be Furnished by the Contractor. (a) Working or shop drawings shall be submitted only by the Contractor for approval by the Officer-in-Charge. Upon approval by the Officer-in-Charge, such drawings shall become part of the contract documents. The Contractor shall not proceed with work and shall not order any material, equipment, or device affected by such drawings, until such drawings are approved by the Officer-in-Charge.

(b) The Contractor shall submit six (6) copies of working or shop drawings and/or catalog cuts for fabricated items and manufactured items (including mechanical and electrical equipment). Submission shall be made in sufficient time to allow the Officer-in-Charge not less than twenty-one (21) calendar days for examining submissions, unless such submissions are for major equipment that requires review by more than one engineering discipline, in which case the time period shall be increased to thirty (30) calendar days.

(c) Drawing size shall be (8.5" x 11"), (11" x 17"), or (24" x 36"). Drawings shall be accurate, distinct, and complete, and shall contain all required information, including satisfactory identification of items, units, and assemblies in relation to the contract drawings and specifications.

(d) The Contractor shall mark drawings by a signed stamp, or other approved means, indicating that the Contractor has checked the shop drawings, and that the work shown is in accordance with contract requirements and has been checked for dimensions and relationship with work of all other trades involved. The practice of submitting incomplete or unchecked drawings will not be acceptable and will be returned to the Contractor for re-submission in the proper form.

(e) After the Officer-in-Charge's review, two (2) sets of submissions will be returned to the Contractor appropriately stamped. If major changes or corrections are necessary, the drawings may be rejected and will be returned to the Contractor with one (1) set of the submissions indicating such changes or corrections, and the Contractor shall correct and resubmit six (6) revised copies.

No changes shall be made by the Contractor to resubmitted shop drawings other than those changes indicated by the Officer-in-Charge.

(f) The Officer-in-Charge's review of shop and working drawings and catalog cuts shall not relieve the Contractor from responsibility for correctness of dimensions, fabrication details, and space requirements.

(g) Operation and maintenance data shall be assembled in three ring binders (Slant "D" style), which shall be indexed and tabbed. The Contractor shall provide six (6) copies of originals (not photocopies) of the operation and maintenance data to the Officer-in-Charge.

6.22 Contract Documents to be Kept on Project Site. The Contractor shall keep a copy of the contract documents at the project site, and in such a location where they shall be readily accessible for reference.

6.23 Additional Plans to be Furnished by the Officer-in-Charge. The construction plans are intended to be fairly comprehensive and indicate in detail the scope of the work. If during the progress of construction, the Contractor should request supplemental plans to clarify or define in greater detail the intent of the contract documents, the Officer-in-Charge may furnish such supplemental plans, and such additional plans shall become a part of the contract documents, and the Contractor shall perform the work in conformance with such supplemental plans.

6.24 Personal Supervision. (a) The Contractor shall either be personally present or have a responsible representative, authorized to act on behalf of the Contractor, at the project site at all times.

(b) The Contractor shall provide the Officer-in-Charge, in writing, with the name(s) of the Contractor's representative(s).

6.25 Character of Workers, Methods, and Equipment. (a) The Contractor shall employ persons who possess the skills required to perform the work under the contract.

(b) When required by the Officer-in-Charge, the Contractor shall replace any employee who lacks the skill to perform the work assigned to such employee, or is discourteous or disorderly while performing such work. A person who has been replaced may be assigned other work with the approval of the Officer-in-Charge.

(c) The Contractor shall use proper and efficient methods and equipment based upon standard construction industry practices for the performance of the contract.

6.26 Lines and Grades. (a) The laying out of base lines, establishment of grades and staking out the entire work shall be done by a surveyor or civil engineer licensed in the State of Hawaii at the expense of the Contractor, and the Contractor shall be solely responsible for their accuracy. The Contractor shall be responsible for costs of replacing the horizontal and vertical control points or monuments if disturbed or destroyed by the Contractor.

(b) Should any discrepancy be discovered in the dimensions given in the plans, the Contractor shall immediately notify the Officer-in-Charge before proceeding any further with the work, otherwise the Contractor will be held responsible for any costs involved in correction of construction placed due to such discrepancy.

6.27 Contractor's Entry Upon Private Properties. Unless explicitly stated in the contract documents or informed in writing by the Officer-in-Charge, the Contractor is not authorized to enter any property other than the project site. If the Contractor enters any property,

whether authorized by the landowner or any other person claiming an interest in the property, or without any authorization, and causes property damage, personal injury, or wrongful death thereupon, the Contractor shall be responsible to settle any and all claims made by the landowner or person claiming an interest in the property.

6.28 Existing Underground Improvements. (a) Whenever the existence of drainage, gas, oil, sewer, or water pipelines (if applicable, see also Article 301.10 of the Water Systems Standards); cable TV, electric, or telephone lines, or other underground utility facilities are indicated in the construction plans, or are not indicated in the construction plans, but inquiries indicate their existence, the Contractor shall exercise utmost caution, keeping in mind the possible existence of unrecorded laterals and other incidental facilities, and protect all such improvements from damage. The Contractor shall be responsible for any and all damages to all such improvements resulting from its operations.

(b) The Contractor is not eligible for additional compensation and shall not make any claims against the County for extra effort required to prevent any damages or extra work caused or resulting from its operations under this Subsection.

6.29 Quality of Materials. All materials furnished and installed shall be new, be of standard quality of their respective kinds, and be free of defects. Rejected materials must be removed from the project site immediately or within such time as allowed by the Officer-in-Charge and replaced with materials of the quality required by the contract documents. Failure by the Officer-in-Charge to reject materials or to require the removal of such rejected materials shall not relieve the Contractor from responsibility as to the quality and character of materials used on the project.

6.30 Defective Work. Any defective work which may be discovered before the completion of the work shall be corrected as soon as possible. The fact that the Officer-in-Charge may not be aware of defective work shall not constitute the acceptance of the same. Payment, whether partial or final, shall not be construed to be an acceptance of defective work or improper material.

6.31 Inspectors. (a) The Officer-in-Charge may place inspectors on the project. They shall have free access to inspect any and all portions of the project at all times and shall be afforded all means to inspect the materials furnished and work performed on the project. No defective or noncomplying material or workmanship will be considered as accepted as a consequence of the failure of the inspectors to discover or to point out said defects or deficiencies during the construction; nor will the presence of inspectors on the project relieve the Contractor from responsibility for securing the quality and progress of work required by the contract documents.

(b) The inspectors may not alter or waive the provisions of the contract, issue instructions contrary to the contract, or act as foreman for the Contractor. The inspectors shall be free to perform their duties at all times and any intimidation of any inspector by the Contractor or the Contractor's agents or employees, shall be sufficient reason for the County to terminate the contract.

(c) If the Contractor wishes to work at such time of the day which is during the period other than the regular business hours of the County, or on a Saturday, Sunday, or legal State/County holiday, the Contractor shall submit a written request to the Officer-in-Charge for inspection services during such period not less than forty-eight (48) hours in advance of the time when such inspection services are required. If the Contractor's request is granted, the Contractor shall pay the County at the rate per hour designated by the County for each inspector provided. A deposit of legal tender or certified check in an amount estimated by the County to be the cost of be incurred by the County. The Contractor shall be refunded any unused portion of the deposit or be

responsible for additional payment based on actual cost incurred by the County for the additional inspection. The County may reject the request for additional inspection services, and consequently deny the Contractor's request to work overtime if inspectors are not available during the period the Contractor is planning to work.

6.32 Findings Confidential. Any reports, information, or data which the County deems confidential and is given to or prepared or assembled by the Contractor under the contract shall not be made available to any individual or entity by the Contractor without the prior written approval of the Officer-in-Charge.

6.33 Ownership Vested in County. It is expressly understood that any and all equipment, materials, data, information, results and any other thing derived or obtained directly or indirectly as a result of the contract, including, but not limited to, equipment, materials, data, information, and results shall be the sole and exclusive property of the County and that the Contractor shall have no interest, right or title to or in any of the foregoing.

6.34 Pollution. In accordance with Section 103D-411, HRS, the Contractor shall control any pollution in accordance with applicable federal, state, and county regulations when pollution is encountered in the performance of the contract. The Contractor shall immediately notify the Officer-in-Charge if pollution is encountered in the performance of the contract.

6.35 Best Efforts. Contractor agrees that it will, at all times, faithfully, industriously, and to the best of Contractor's ability, experience and talents, perform all of the duties that may be required of Contractor pursuant to the express and implicit terms hereof to the reasonable satisfaction of the County, as determined by the Officer-in-Charge.

6.36 Clean Up. Upon the completion of the work, the Contractor shall remove all temporary structures, surplus materials, rubbish, and obstructions. Should the Contractor fail to do so, the Officer-in-Charge may undertake the work and deduct the cost of performing such work from compensation due the Contractor.

6.37 Responsibility of the Contractor Prior to Final Acceptance of the Work. The Contractor shall be responsible for the work until final acceptance by the County. Use of any portion of the work which may be necessitated by tie-ins to existing and live water systems and which portion of the work must be kept live and use of other portions of the work other than water system improvements by the public, with or without permission by the County, shall not be construed as an acceptance of the work and shall not relieve the Contractor from its responsibility hereunder.

6.38 Substantial Completion. (a) The Contractor, on considering the work to be substantially complete and ready for its intended use, shall so notify the Officer-in-Charge in writing. The notification shall include an itemized list of remaining incomplete work. If the Officer-in-Charge determines that the work is not substantially complete, the Officer-in-Charge will so notify the Contractor in writing identifying the reasons for such a determination. If the Officer-in-Charge finds the work substantially complete, the Officer-in-Charge will meet with the Contractor to:

- (1) Prepare a punch list of incomplete work items;
- (2) Define the division of responsibility between County and Contractor with respect to security, operation, maintenance, heat utilities, insurance, and warranties, and;
- (3) Describe an other issues related to acceptance of the substantially completed work.

The Officer-in-Charge will notify the Contractor in writing of the terms of the County's acceptance of substantial completion. The written notification shall include a punch list of incomplete work items, set the date for their completion, describe the division of responsibility between the County and Contractor, and describe any other terms of acceptance of substantial completion. The Contractor shall acknowledge, in writing, acceptance of all terms specified in the written notice before the project is determined substantially complete by the County.

(b) Upon receipt of the Contractor's written acknowledgment, the County shall take possession of the work or portion of the work and put it into its intended service. The date that the work or portion of the work is put into service will become the date of substantial completion.

(c) Subsequent to the substantial completion date, the County may exclude the Contractor from the work during such periods when construction activities might interfere with the operation of the project. The County, however, shall allow the Contractor reasonable access for completion or correction of incomplete punch list items.

(d) Except for any portion(s) of work specified for early completion or required by the County for early possession, substantial completion will not occur for any work until the entire project is ready for possession and use.

(e) The Officer-in-Charge shall have sole discretion for determination of substantial completion.

6.39 Possession of Portions of the Project. Should the Contractor fail to meet any date specified for substantial completion of the work or any portion of the work requiring early possession and use by the County, the County may, after a 10-day written notice to the Contractor, take over such portion or all of the work that is behind schedule. In such case, the Officer-in-Charge will prepare a punch list of incomplete work. The County may allow the Contractor reasonable access to the work at such times that the operation of the project will not be affected or the County may complete the work itself after giving the Contractor notice of the County's intention to do so. The cost of County's work will be charged to and deducted from amounts due to the Contractor. The substantial completion date will be established as the date when the County actually begins using the project or portion of the project for its intended purpose. Division of responsibilities between the County and Contractor, beginning of warranties, and any other issues relating to substantial completion shall be as specified in the contract.

6.40 Acceptance of the Project. (a) Upon completion of the work, including portions of the work previously accepted as substantially complete, the Contractor shall so notify the Officer-in-Charge in writing. Upon receipt of the notification, the Officer-in-Charge will determine if the work conforms to the terms of the contract. If the Officer-in-Charge finds materials, equipment, or workmanship which do not meet the terms of the contract, the Officer-in Charge shall prepare a punch list of such items and submit it to the Contractor. Following completion of the corrective work by the Contractor, the Contractor shall notify the Officer-in-Charge that the work has been completed in accordance with the contract. Final determination of the acceptability shall be made by the Officer-in-Charge. Upon acceptance of the project, the Officer-in-Charge shall immediately file a notice of completion. For portions of the project not previously accepted as substantially complete, the conditions of guarantee shall commence on the date that the Officer-in-Charge files a notice of completion.

(b) The final application for payment shall be accompanied by all required documentation called for in the contract including complete and legally effective releases or waivers of liens in a form acceptable to the County. Subject to prior approval of the County, the Contractor may submit in lieu of the lien releases and waivers: (1) receipts of releases in full; (2) an affidavit that the releases and receipts cover all labor, services, materials, and equipment for which a lien could be

filed and that all payrolls, materials, and equipment bills and other indebtedness connected with the work for which the County or the County's property might in any way be responsible have been paid or otherwise satisfied; and (3) consent of the surety, if any, to final payment.

(c) If any subcontractor or supplier fails to furnish a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to the County to indemnify the County against any lien.

(d) If, after reviewing the Contractor's final application for payment including all documentation required, the Officer-in-Charge determines that the work is complete, the Officer-in-Charge will recommend that final payment, including all retainages, be made by the County. The final payment will be due and payable by the County within thirty (30) days after any legal notice periods have expired.

6.41 Warranty. (a) The Contractor and Contractor's sureties shall be responsible for the work for a period of one (1) year following final acceptance to be free from defects in workmanship and materials. Product warranties, as applicable, beyond the one (1) year Contractor warranty shall be secured in the name of the County of Maui and furnished to the County prior to final payment request.

(b) The performance and payment bond shall remain in force during the Contractor's warranty period, or the Contractor may elect to withdraw the performance and payment bond and deposit a replacement bond in an amount not less than ten percent (10%) of the final contract price; provided that the Contractor and Contractor's sureties for the replacement bond shall be responsible for any and all costs which exceed the replacement bond amount during the warranty period.

(c) The Contractor and Contractor's sureties shall be responsible for the repair or replacement, or both, of all defective work or materials.

(d) If the Contractor or Contractor's sureties fail to perform the responsibilities under this Subsection in a timely manner, the Officer-in-Charge may undertake or cause the undertaking of such work, and the Contractor and Contractor's sureties shall be responsible for all costs thereunder.

(e) If the work or any portion thereof fails, and the Officer-in-Charge determines that the public's safety, health, or welfare is jeopardized, the Officer-in-Charge may, with or without notice to the Contractor or the Contractor's surety, undertake the repair or replacement work, and the Contractor and Contractor's sureties shall be responsible for all costs incurred by the County.

Section 7 – Compensation

7.01 Compensation. The Contractor shall be paid the amount stated in the contract less any reduction in compensation and plus any increase in compensation pursuant to the contract change order and modification Sections herein, as full compensation for the performance of the services under the contract.

7.02 Compensation Retained. (a) The County may retain a portion of the amount due under the contract to the Contractor to insure proper performance of the contract, provided that the sum withheld shall not exceed five percent (5%) of the amount due the Contractor and that after fifty percent (50%) of the contract is completed and progress is satisfactory, no additional sum shall be withheld; provided further that if progress is not satisfactory, the Procurement Officer may continue to withhold as compensation retained sums not exceeding five percent (5%) of the amount due the Contractor; provided further that the compensation retained shall not include sums

deducted and withheld separately as liquidated damages from moneys due or that may become due the Contractor under the contract.[§103-32.1(a), HRS]

(b) The retention amount withheld by the Contractor from its subcontractors shall be the same percentage of compensation retained as that of the Contractor, provided that the subcontractor has provided evidence to the Contractor of:

- (1) A valid performance and payment bond for the project that is acceptable to the Contractor and executed by a surety company authorized to do business in the State of Hawaii;
- (2) Any other bond acceptable to the Contractor; or
- (3) Any other form of collateral acceptable to the Contractor.

This Subsection shall also apply to the subcontractors who subcontract work to other subcontractors. [§103-32.1(b), HRS]

(c) The County may enter into an agreement with the Contractor which will allow the Contractor to withdraw from time to time the whole or any portion of the sum retained under Sub-Paragraph (a) upon depositing with the County any general obligation bond of the State or its political subdivisions with a market value not less than the sum to be withdrawn; provided that the County may require that the total market value of such bond be greater than the sum to be withdrawn. [§103-32.2, HRS]

7.03 Monthly Progress Payments. (a) The County shall pay the Contractor monthly progress payments based on the actual quantities of work done and the actual quantities of materials delivered to and safely stored at a site approved by the County. The Contractor shall submit monthly progress payment request to the Officer-in-Charge no later than the fifth (5th) day of each month for work performed during the previous calendar month.

(b) Subject to the retainage provisions of Subsection 7.02 – Compensation Retained, the County shall pay the Contractor an amount equal to the value of the completed and installed portion of the work for which the Contractor certifies has not previously been paid. The County shall also pay the Contractor for seventy-five percent (75%) of the value of materials furnished, delivered and stored in an approved manner, provided that:

- (1) A copy of the paid receipts for the stored materials must be submitted with the pay estimate;
- (2) Fire and Standard Extended Coverage Insurance is required if payment for stored materials is requested; and
- (3) Payment for perishable stored materials, such as live plants and similar materials, will not be allowed.

(c) The Officer-in-Charge may decline to process a progress payment request if the total value of the work done since last estimate is less than \$1,000.

(d) Monthly progress payments may be subject to compensation retained.

7.04 Death or Disability of Contractor. In the case of an individual Contractor, if the Contractor dies or becomes physically or mentally disabled, the Contractor or the Contractor's

estate shall be compensated in the same proportion of the compensation under the contract as the services performed bear to the services to be performed under the contract.

7.05 Campaign Contributions Prohibited. It is understood and agreed by the Parties that no portion of the Contractor's compensation to be paid under the terms of the contract shall be used as a campaign contribution.

7.06 Authority to Withhold Money Due or Payable. The Procurement Officer may withhold such amounts from the money due or to become payable under the contract to the Contractor, or any assignee thereof, as may be necessary to protect the County against liability, to satisfy the obligations of the Contractor to the County, employees, subcontractors and material men who have performed labor or furnished material and equipment under the contract, or to satisfy any outstanding debts owed to the County by the Contractor and may make such payments from such amounts as may be necessary to discharge such obligations, satisfy County debts and protect the County.

7.07 Final Payment – Final Acceptance. (a) Final payment will be made only after the issuance of a notice of final approval and acceptance by the Officer-in-Charge advising the Contractor of the satisfactory fulfillment of the terms of the contract, provided that the Director of Finance has determined that the Contractor has fully satisfied all outstanding debts to the County. Acceptance by the Contractor of the final payment shall constitute payment in full for all services performed under the contract.

(b) Upon completion and acceptance of the work under the contract, the County shall pay the Contractor the balance due after deducting previous payments and amounts to be retained or deducted according to the contract.

(c) The County shall not make final payment until the following is received:

- (1) Written consent of the Contractor's sureties on the Contractor's bonds;
- (2) Tax clearance certificate from the State Director of Taxation stating that all delinquent taxes levied or accrued against the Contractor have been paid. The tax clearance for final payment shall be an original certificate with a green certified copy stamp, not over two (2) months old, with box 3a of the application completed for a specific job number, and indicating tax clearances from the Hawaii State Department of Taxation and the Internal Revenue Service on Tax Clearance Application A-6;
- (3) An affidavit stating that payment due to all subcontractors and all persons, companies, corporations for labor, tools, materials, and equipment used in the prosecution of the work under the contract have been paid or have been satisfactorily secured; and
- (4) A "Certification of Compliance for Final Payment" (SPO Form-22).

Section 8 – Contract Amendments/Change Orders

8.01 Change Order. In accordance with Sections 103D-202, HRS and 3-125-4, HAR, the Procurement Officer, at any time, and without notice to any surety, in a signed writing designated or indicated to be a change order, may make changes in the work within the scope of the contract as may be found to be necessary or desirable. Such changes shall not invalidate the contract or release the sureties, and the Contractor shall perform the work as changed, as though it

had been part of the original contract. Minor changes in the work may be directed by the Procurement Officer with no change in contract price or time of performance.

8.02 Adjustments of Price or Time for Performance. In accordance with Section 3-125-4, HAR, if any change order increases or decreases the Contractor's cost of, or the time required for performance of any part of the work under the contract, whether or not changed by the order, an adjustment may be made and the contract modified in writing accordingly.

(a) Any adjustment in contract price shall be determined in accordance with Section 11 – Price Adjustment Clause.

(b) Failure of the parties to agree to an adjustment in time shall not excuse a Contractor from proceeding with the contract as changed, provided that the Procurement Officer, within fourteen (14) days after the changed work commences, makes such provisional adjustments in time as the Procurement Officer deems reasonable.

(c) The right of the Contractor to dispute the contract price or time required for performance or both shall not be waived by its performing the work, provided however, that it follows written notice requirements for disputes and claims established by the contract.

(d) The County may choose to formalize a change to the scope of work or contract time by a contract amendment.

8.03 Time Period for Claim. Within thirty (30) days after receipt of a written change order under Paragraph 8.01, unless such period is extended by the Procurement Officer in writing, the Contractor shall file a notice of intent to assert claim for an adjustment. The requirement for timely written notice cannot be waived and shall be a condition precedent to the assertion of a claim.

8.04 Claim Barred After Final Payment. No claim by the Contractor for an adjustment hereunder shall be allowed if written notice is not given prior to final payment under the contract.

8.05 Other Claims Not Barred. In the absence of such a change order, nothing in this Section shall restrict the Contractor's right to pursue a claim arising under the contract or for breach of contract.

Section 9 – Stop Work Orders

9.01 Suspension of Work. The Procurement Officer may, by written order, suspend the performance of the work, either in whole or in part for periods as the Procurement Officer may deem necessary for any cause, including but not limited to:

(a) Weather or soil conditions unsuitable for prosecuting of the work;

(b) Failure on the part of the Contractor to:

(1) Correct conditions unsafe for the general public or for the workers;

(2) Carry out orders given by the Procurement Officer;

(3) Perform the work in strict compliance with the provisions of the contract; or

(4) Provide adequate supervision on the job site.

(c) Whenever a redesign that may affect the work is deemed necessary by the Procurement Officer;

(d) Unacceptable noise or dust arising from the construction even if it does not violate any law or regulation; or

(e) The convenience of the County.

9.02 Partial and Total Suspension. Suspension of work on some but not all items of work shall be considered a “partial suspension”. Suspension of work on all items shall be considered “total suspension”. The period of suspension shall be computed from the date set out in the written order for work to cease until the date of the order for work to resume.

9.03 Reimbursement to Contractor. In the event that the Contractor is ordered by the Procurement Officer in writing as provided herein to suspend all work under the contract in accordance with Paragraph (c), (d), or (e) of Subsection 9.01 – Suspension of Work, the Contractor may be reimbursed for actual money expended towards the project during the period of suspension. No allowance will be made for anticipated profits.

9.04 Cost Adjustment. If the performance of all or part of the work is suspended for reasons beyond the control of the Contractor, an adjustment shall be made for any increase in the cost of performance of the contract (excluding profit) necessarily caused by such suspension, and the contract modified in writing accordingly. However, no adjustment shall be made under this clause for any suspension:

(a) To the extent that performance would have been so suspended, delayed, or interrupted by any other cause, including the fault or negligence of the Contractor; or

(b) For which an adjustment is provided for or excluded under any other provision of the contract.

9.05 Claims for Adjustment. Any adjustment in contract price made pursuant to this clause shall be determined in accordance with the provisions on changes and claims for adjustment. Claims for compensation shall be filed in writing with the Procurement Officer within thirty (30) days after the date of the order to resume work or the claims will not be considered. Together with the claim, the Contractor shall submit substantiating documents covering the entire amount shown on the claim. The Procurement Officer shall take the claim under consideration, may make such investigations as are deemed necessary, and shall be the sole judge as to the equitable nature of the claim. The Procurement Officer's decision shall be final.

9.06 No Adjustment. No provision of this Section shall entitle the Contractor to any adjustments for delays due to failure of surety, suspensions made at the request of the Contractor, any delay required under the contract, or suspensions, either partial or whole, made by the Procurement Officer under Paragraph (b) of Subsection 9.01 - Suspension of Work.

Section 10 – Variations in Estimated Quantities

10.01 Variations Requiring Adjustments. Where the estimated quantity of a pay item in the contract is an estimated quantity and where the actual quantity of such pay item varies by more than fifteen percent (15%) above or below the estimated quantity in the contract, an adjustment in the contract price shall be made upon demand of either party. The adjustment shall be based upon any increase or decrease in costs due solely to the variation above one hundred fifteen percent (115%) or below eighty-five percent (85%) of the estimated quantity. If the quantity

variation is such as to cause an increase in the time necessary for completion, the Procurement Officer shall, upon receipt of a timely written request for an extension of time, prior to final payment of the contract, ascertain the facts and make such adjustment for extending the completion date as in the judgment of the Procurement Officer the findings justify.

10.02 Adjustment of Price. Any adjustment in contract price shall be determined in accordance with Section 11 - Price Adjustment Clause.

Section 11 – Price Adjustment Clause

11.01 Price Adjustment. Any adjustment in contract price pursuant to a clause in the contract shall be made in one or more of the following ways.

- (a) By agreement on a fixed price adjustment before commencement of the pertinent performance;
- (b) By unit prices specified in the contract or subsequently agreed upon before commencement of the pertinent performance;
- (c) By the costs attributable to the events or situations under such clauses with adjustment of profit or fee, all as specified in the contract or subsequently agreed upon before commencement of the pertinent performance;
- (d) In any other manner as the parties may mutually agree upon before commencement of the pertinent performance; or
- (e) In the absence of agreement between the Parties, the provisions of Section 103D-501(b)(5), HRS shall apply.

11.02 Submission of Cost or Pricing Data. The Contractor shall be required to submit cost or pricing data if any adjustment in contract price is subject to the provisions of Section 103D-312, HRS (Cost or pricing data), as amended. The submission of any cost or pricing shall be made subject to the provisions of Subchapter 15, Chapter 3-122, HAR. A fully executed change order or other document permitting billing for the adjustment in price under any method listed in Paragraphs 11.1(a) through 11.1(d) shall be issued within ten (10) days after agreement on the method of adjustment.

11.03 Determining the Adjustments in Price. (a) In determining the adjustment in price to the County resulting from a change, the allowances for all overhead, extended overhead resulting from adjustments to contact time (including home office and branch office overhead) and profit combined shall not exceed the percentages set forth below:

- (1) For the Contractor, for any work performed by its own forces, twenty percent (20%) of the cost;
 - (2) For each subcontractor, for any work performed by its own forces, twenty percent (20%) of the cost;
 - (3) For the Contractor or any subcontractor, for work performed by their subcontractors, ten percent (10%) of the amount due the performing subcontractor.
- (b) In no event shall overhead and profit exceed a total of twenty percent (20%) of direct costs, regardless of the number of tier subcontractors.

(c) The Contractor may add up to one percent (1%) of direct costs for bonds.

(d) If the bid contains lump sum items, the Officer-in-Charge may delete the lump sum item, which shall be deducted from the contract price based on the bid price of the lump sum item.

(e) If the bid contains unit price items, the Officer-in-Charge may increase or decrease the quantities of such items, or delete such items in their entirety. If quantities are increased, the Contractor shall perform such work at the unit price bids for such items. If quantities are decreased or such unit price items are deleted in their entirety, the deductions from the contract price shall be based on the unit price bids for such items.

11.04 Change Order Work by Force Account. (a) Compensation for change work by force account (time and expenses basis) shall be an amount equal to the sum of the following items:

- (1) The cost to the Contractor of all material delivered for the change order work evidenced by bills or vouchers;
- (2) The cost of all labor including foremen, except general superintendence, necessary to incorporate the above material in the change work or to finish the change order if no materials are required, to be determined from the Contractor's payrolls or by inspections performed by the inspectors, or both;
- (3) Ten percent (10%) of the amount from Sub-Paragraph (2), which shall be considered as covering the cost of superintendence, hand tools, and clerical work in connection with the change order work and the Contractor's overhead costs;
- (4) A rental charge for the use of all construction equipment approved by the Officer-in-Charge. The rental rates shall be agreed upon by the Contractor and the Officer-in-Charge, and may or may not, include the cost of fuel oil, gasoline, electric energy, lubricating oil, repairs, and maintenance. The Contractor shall submit a proposed schedule of equipment rental charges to the Officer-in-Charge for approval prior to entering into a change order. The cost of small tools shall not be included;
- (5) The cost of workers' compensation insurance and public liability premiums, unemployment tax, social security tax, or other taxes on the labor for Sub-Paragraph (2);
- (6) Fifteen percent (15%) of the sums of Sub-Paragraphs (1) through (4), which shall be considered as covering all other expenses and profit;
- (7) Where force account work is performed by a subcontractor, the Contractor may add five percent (5%) to the subcontractor's computed compensation to cover its overhead and profit, provided that overhead and profit shall be limited to a total of twenty percent (20%) of direct costs;
- (8) One percent (1%) of direct costs for Paragraphs (1) through (7) for bonds. The addition for bond cost is applicable only to the Contractor's compensation; and
- (9) The cost of state excise tax on the sum of Paragraphs (1) through (8).

(b) The performance of change order work on a force account basis shall be under the supervision of the Officer-in-Charge, and the Officer-in-Charge's decision shall be final. The method of performing such work, the equipment to be used, and the amount and character of labor

to be employed shall meet with the approval of the Officer-in-Charge. The force account formula may also apply to deleted work.

(c). Whenever the Contractor is directed to perform extra work on a time and expense basis, the Contractor will maintain accurate records. Each day a record of labor, materials and equipment costs shall be submitted to the Officer-in-Charge for verification. These records shall reflect the actual and necessary expenses pertaining to the extra work and shall be available for audit. Audits conducted under this provision shall be in accordance with generally acceptable auditing standards and established procedures and guidelines of the reviewing or auditing agencies.

11.05 Materials Ordered. If the Officer-in-Charge deletes any item, or decreases the quantity of any item in the bid, and the Contractor has already ordered materials involved in such deletions or decreases, the Contractor shall make every effort to return the materials if requested by the Officer-in-Charge. If the materials are returnable, the County shall pay the actual costs incurred to the Contractor to return the materials evidenced by receipt or invoice. If the materials cannot be returned, the County shall pay the actual cost to the Contractor of the materials evidenced by receipt or invoice; provided that the materials are free from defect upon inspection and acceptance by the County. Materials ordered prior to the issuance of the Notice to Proceed shall be the Contractor's responsibility and the County will not make payment for such materials.

11.06 Work by County. If additional work is required to complete the contract, the County reserves the right to (1) perform the additional work itself; and (2) employ another contractor to perform the work. The Contractor shall fully cooperate with the County to schedule the completion of the additional work.

Section 12 – Differing Site Conditions

12.01 Notification. The Contractor shall promptly, and before such conditions are disturbed, notify the Procurement Officer of:

(a) Subsurface or latent physical conditions at the site differing materially from those indicated in the contract; or

(b) Unknown physical conditions at the site, of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the contract.

12.02 Adjustments of Price or Time of Performance. After receipt of the notice, the Procurement Officer shall promptly investigate the site, and if it is found that the conditions do materially so differ and cause an increase in the Contractor's cost of, or the time required for, performance of any part of the work under the contract, whether or not changed as a result of the conditions, an adjustment shall be made and the contract modified in writing accordingly. Any adjustment in contract price made pursuant to this Section shall be determined in accordance with Section 11 - Price Adjustment Clause.

12.03 Timeliness of Claim. No claim of the Contractor under this Section shall be allowed unless the Contractor has given the notice required in this Section; provided, however, that the time prescribed therefore may be extended by the Procurement Officer in writing.

12.04 No Claim After Final Payment. No claim by the Contractor for an adjustment thereunder shall be allowed if asserted after final payment under the contract.

12.05 Knowledge. Nothing contained in this Section shall be grounds for an adjustment in compensation if the Contractor had actual knowledge of the existence of such conditions prior to the submission of bids.

Section 13 – Novation or Change of Name

13.01 No Assignment. No County contract is transferable, or otherwise assignable, without the written consent of the Procurement Officer. A Contractor may assign monies receivable under a contract with written consent of the Procurement Officer.

13.02 Recognition of a Successor in Interest; Assignment. When in the best interest of the County, a successor in interest may be recognized in an assignment agreement in which the transferor, the transferee and the County shall agree that:

13.03 Change of Name. When a Contractor requests to change the name in which it holds a contract with the County, the Procurement Officer shall, upon receipt of a document indicating such change of name (for example, an amendment to the articles of incorporation of the corporation), enter into a novation agreement with the requesting Contractor to effect such a change of name. The agreement changing the name shall specifically indicate that no other terms and conditions of the contract are thereby changed.

Section 14 – Claims Based on Oral Directives

14.01 Notice Required. Any oral order, direction, instruction, interpretation, or determination from the Procurement Officer which, in the opinion of the Contractor, causes any change, can be considered as a change only if the Contractor gives the Procurement Officer written notice of its intent to treat the oral order, direction, instruction, interpretation, or determination as a change directive. The written notice must be delivered to the Procurement Officer before the Contractor acts in conformity with the oral order, direction, instruction, interpretation, or determination, but not more than five (5) days after delivery of the oral order to the Contractor. The written notice shall state the date, circumstances, whether a time extension will be requested, and source of the order that the Contractor regards as a change. The written notice may not be waived and shall be a condition precedent to the filing of a claim by the Contractor. Unless the Contractor acts in accordance with this procedure, any oral order shall not be treated as a change and the Contractor waives any claim for an increase in the contract time or contract price related to the work.

14.02 Change Order Issued. Not more than five (5) working days after receipt of the written notice from the Contractor, the Procurement Officer shall issue a change order for the subject work if the Procurement Officer agrees that it constitutes a change. If no change order is issued in the time established, it shall be deemed a rejection of the Contractor's claim for a change. If the Contractor objects to the Procurement Officer's refusal to issue a change order, it shall file a written protest with the Procurement Officer within thirty (30) days after delivery to the Procurement Officer of the Contractor's written notice of its intention to treat the oral order as a change. In all cases the Contractor shall proceed with the work. The protest shall be determined as provided in Section 17 - Remedies.

Section 15 – Default, Delay, and Time Extensions

15.01 Default. If the Contractor refuses or fails to perform the work, or any separable part thereof, with such diligence as will assure its completion within the time specified in the contract, or any extension thereof, fails to complete the work within such time, or commits any other substantial breach of the contract, and further fails within seven (7) days after receipt of written

notice from the Procurement Officer to commence and continue correction of the refusal or failure with diligence and promptness, the Procurement Officer may, by written notice to the Contractor, declare the Contractor in breach and terminate the Contractor's right to proceed with the work or the part of the work as to which there has been delay or other breach of contract. In that event, the County may take over the work and perform the same to completion, by contract or otherwise, and may take possession of, and utilize in completing the work, the materials, appliances, and plant as may be on the site of the work and necessary therefor. Whether or not the Contractor's right to proceed with the work is terminated, the Contractor and the Contractor's sureties shall be liable for any damage to the County resulting from the Contractor's refusal or failure to complete the work within the specified time.

15.02 Liquidated Damages Upon Termination. If fixed and agreed liquidated damages are provided in the contract, and if the County so terminates the Contractor's right to proceed, the resulting damage will consist of the liquidated damages for the time as may be required for final completion of the work.

15.03 Liquidated Damages in Absence of Termination. If fixed and agreed liquidated damages are provided in the contract, and if the County does not terminate the Contractor's right to proceed, the resulting damage will consist of liquidated damages accumulated until the work is completed or accepted.

15.04 Time Extension. The Contractor's right to proceed shall not be so terminated nor shall the Contractor be charged with resulting damage if:

(a) The delay in the completion of the work arises from causes such as: acts of God; acts of the public enemy; acts of the State and any other governmental entity in either a sovereign or contractual capacity; acts of another Contractor in the performance of a contract with the County; fires; floods; epidemics; quarantine restrictions; strikes or other labor disputes; freight embargoes; unusually severe weather; delays of subcontractors due to causes similar to those set forth above; or shortage of materials; provided, however, that no extension of time will be granted for a delay caused by a shortage of materials, unless the Contractor furnishes to the Procurement Officer proof that the Contractor has diligently made every effort to obtain the materials from all known sources, and further proof that the inability to obtain the materials when originally planned did in fact cause a delay in final completion of the entire work which could not be compensated for by revising the sequence of the Contractor's operations; and

(b) The Contractor, within ten (10) days from the beginning of the delay (unless the Procurement Officer grants a further period of time before the date of final payment under the contract), notifies the Procurement Officer in writing of the causes of delay. The Procurement Officer shall ascertain the facts and the extent of the delay and extend the time for completing the work when, in the judgment of the Procurement Officer, the findings of fact justify such an extension.

15.05 Additional Rights and Remedies. The rights and remedies of the County provided in the contract are in addition to any other rights and remedies provided by law.

Section 16 – Termination for Convenience

16.01 Terminations. The Procurement Officer may, when the interests of the County so require, terminate the contract in whole or in part, for the convenience of the County. The Procurement Officer shall give written notice of the termination to the Contractor specifying the part of the contract terminated and when termination becomes effective.

16.02 Contractor's Obligations. The Contractor shall incur no further obligations in connection with the terminated work, and on the date set in the notice of termination the Contractor will stop work to the extent specified. The Contractor shall also terminate outstanding orders and subcontracts as they relate to the terminated work. The Contractor shall settle the liabilities and claims arising out of the termination of subcontracts and orders connected with the terminated work subject to the County's approval. The Procurement Officer may direct the Contractor to assign the Contractor's right, title, and interest under terminated orders or subcontracts to the County. The Contractor must still complete the work not terminated by the notice of termination and may incur obligations as necessary to do so.

16.03 Right to Construction and Goods. The Procurement Officer may require the Contractor to transfer title and deliver to the County in the manner and to the extent directed by the Procurement Officer.

(a) Any completed constructions; and

(b) The partially completed construction, goods, materials, parts, tools, dies, jigs, fixtures, plans, drawings, information, and contract rights (hereinafter called "construction material") as the Contractor has specifically produced or specially acquired for the performance of the terminated part of the contract. The Contractor shall protect and preserve property in the possession of the Contractor in which the County has an interest. If the Procurement Officer does not exercise this right, the Contractor shall use the Contractor's best efforts to sell the construction, goods, and construction materials in accordance with the standards of Section 490:2-706, HRS. This in no way implies that the County has breached the contract by exercise of the termination for convenience clause.

16.04 Compensation. (a) The Contractor shall submit a termination claim specifying the amounts due because of the termination for convenience together with cost or pricing data, submitted to the extent required by Sub-Chapter 15, Chapter 3-122, HAR, bearing on such claim. If the Contractor fails to file a termination claim within one year from the effective date of termination, the Procurement Officer may pay the Contractor, if at all, an amount set in accordance with Clause (2) of Paragraph (c).

(b) The Procurement Officer and the Contractor may agree to a settlement provided the Contractor has filed a termination claim supported by cost or pricing data submitted as required and that the settlement does not exceed the total contract price plus settlement costs reduced by payments previously made by the County, the proceeds of any sales of construction, goods, and construction materials under Clause (3) of Paragraph (c), and the contract price of the work not terminated.

(c) Absent complete agreement under Paragraph (b), the Procurement Officer shall pay the Contractor the following amounts, provided payments under Paragraph (b) shall not duplicate payments under this Paragraph, for the total (without duplication of any items) of:

(1) The cost of all contract work performed prior to the effective date of the notice of termination plus a five percent (5%) markup on actual direct costs on the portion of the work (the markup shall not include anticipatory profit or consequential damages) less amounts paid or to be paid for completed portions of the work; provided, however, that if it appears that the Contractor would have sustained a loss if the entire contract would have been completed, no markup shall be allowed or included and the amount of compensation shall be reduced to reflect the anticipated rate of loss;

(2) Subject to the prior approval of the Procurement Officer, the costs of settling and paying claims arising out of the termination of subcontracts or order pursuant to the “Contractor’s obligations” provisions of the contract. Subcontractors shall be entitled to a markup of no more than ten percent (10%) on direct costs incurred to the date of termination. These costs must not include costs paid in accordance with Clause (1);

(3) The total sum to be paid to the Contractor under this Paragraph shall not exceed the total contract price reduced by the amount of any sales of construction, goods, and construction materials under Subsection 16.03 – Right to Construction and Goods, and the contract price of work not terminated.

(d) Cost claimed, agreed to, or established under Paragraphs (b) and (c) shall be in accordance with Chapter 3-123, HAR.

Section 17 – Remedies

17.01 General. Any dispute arising under or out of the contract is subject to Chapter 3-126, HAR.

17.02 Disputes. (a) All controversies between the County and the Contractor which arise under, or are by virtue of, the Contract and which are not resolved by mutual agreement shall be decided by the Procurement Officer in writing, within ninety calendar days after a written request by the Contractor for a final decision concerning the controversy; provided that if the Procurement Officer does not issue a written decision within ninety calendar days after written request for a final decision, or within such longer period as may be agreed upon by the Parties, then the Contractor may proceed as if an adverse decision had been received.

(b) The Contractor shall comply with any decision of the Procurement Officer and proceed diligently with performance of the contract pending final resolution by the Circuit Court of the Second Circuit, State of Hawaii, County of Maui, of any controversy arising under, or by virtue of, the contract, except where there has been a material breach of contract by the County; provided that in any event the Contractor shall proceed diligently with the performance of the contract where the Procurement Officer has made a written determination that work under the contract is essential to the public health and safety.

(c) Any such decision shall be final and conclusive, unless fraudulent, or unless the Contractor brings an action seeking judicial review of the decision in the Circuit Court of the Second Circuit, State of Hawaii, County of Maui, within the six months from the date of receipt of the decision

(d) The Contractor shall comply with any decision of the Procurement Officer and proceed diligently with performance of the contract pending final resolution by the Circuit Court of the Second Circuit, State of Hawaii, County of Maui, of any controversy arising under, or by virtue of, the contract, except where there has been a material breach of contract by the County; provided that in any event the Contractor shall proceed diligently with the performance of the contract where the Procurement Officer has made a written determination that work under the contract is essential to the public health and safety.

Section 18 – Miscellaneous Provisions

18.01 Severability. If any provision of the contract is held invalid, the other provisions of the contract shall not be affected thereby. If the application of the contract or any of its

provisions as to any person or circumstance is held invalid, the application of the contract and its provisions as to other persons or circumstances shall not be affected thereby.

18.02 Entire Agreement. The contract contains the complete agreement concerning the subject arrangement between the Parties and shall, as of the effective date hereof, supersede all other agreements between the Parties. The Parties stipulate that neither has made any representations with respect to the subject matter, execution and delivery of the contract except as such representations are specifically set forth herein. Each party acknowledges that the party has relied on the party's own judgment in entering into the contract. The Parties further acknowledge that any payments or representations that may have previously been made by either of them to the other are of no effect and that neither has relied thereon in connection with its dealing with the other.

18.03 Notices. (a) Any written notice required to be given by a party to the contract shall be:

- (1) Delivered personally to the Contractor's designated representative on the project site, or
- (2) Sent by United States first class mail, postage prepaid to the party's address listed in the contract.

(b). A notice shall be deemed to have been received three (3) days after mailing or at the time of actual receipt, whichever is earlier. The Contractor shall notify the County in writing of any change of address. The Contractor shall maintain a post office address within the County of Maui and file the same with the Officer-in-Charge prior to or with the execution of the contract. All notices addressed in compliance with the directions of the Contractor and properly mailed shall be effective when mailed, or delivered by any of the above methods.

18.04 Assistance of Legal Counsel. The Parties have carefully read and fully understand all of the provisions and effects of the contract. The Parties shall consult with their respective counsel if any provision of the contract is not fully understood. The Parties are voluntarily entering into the contract and neither Party has made representations concerning the terms or effects of the contract other than those contained herein.

18.05 Applicable Law and Venue. The contract shall be governed by the laws of the State of Hawaii. Any action or court proceeding which may arise from the contract shall be heard in the Circuit Court of the Second Circuit, State of Hawaii, County of Maui.

[END OF GENERAL TERMS AND CONDITIONS]

SPECIAL CONDITIONS FOR CONTRACTS UTILIZING FEDERAL FUNDING, INCLUDING FEMA FUNDING

The contractor shall comply with all applicable federal law, regulations, executive orders, policies, procedures, and directives, including but not limited to the following:

(A) **Violation or Breach of Contract.** If the contract value is in excess of the simplified acquisition threshold, currently set at \$250,000, the contractor is directed to Hawaii Revised Statutes § 103D-703 and Section 17 of the County's General Terms and Conditions for Construction Contracts (the "GT&Cs") attached herewith.

(B) **Termination for Cause or Convenience.** If the contract value is in excess of \$10,000, the contractor is directed to Sections 15 and 16 of the GT&Cs.

(C) **Equal Employment Opportunity.** During the performance of the contract, the contractor agrees as follows:

(1) The contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, 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: 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 by the contracting officer 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 it has a collective bargaining agreement or other contract or understanding, a notice to be provided by the agency contracting officer, advising the labor union or workers' representative of the contractor's commitments under section 202 of Executive Order 11246 of September 24, 1965, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

(5) The contractor will comply with all provisions of Executive Order 11246 of September 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor.

(6) The contractor will furnish all information and reports required by Executive Order 11246 of September 24, 1965, and by the rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records, and accounts by the contracting agency and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

(7) In the event of the contractor's non-compliance with the nondiscrimination clauses of this contract or with any of such 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 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 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 may be directed by the Secretary of Labor as a means of enforcing such provisions including sanctions for noncompliance: Provided, however, that in the event the contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction, the contractor may request the United States to enter into such litigation to protect the interests of the United States.

(D) Davis-Bacon Act. The contractor shall pay wages to laborers and mechanics at a rate not less than the prevailing wages specified in a wage determination made by the Secretary of Labor. In addition, the contractor must be required to pay wages not less than once a week. The contractor is directed to the current prevailing wage determination issued by the Department of Labor in the solicitation. Award of this contract is conditioned upon the acceptance of the wage determination. The contractor must report all suspected or reported violations to the County and the Federal awarding agency.

(E) Copeland “Anti-Kickback” Act: When applicable, the contractor must also comply with the Copeland “Anti-Kickback” Act (40 U.S.C. 3145), as supplemented by Department of Labor regulations. The contractor and any subcontractor are prohibited from inducing, by any means, any person employed in the construction, completion, or repair of public work, to give up any part of the compensation to which he or she is otherwise entitled. The contractor must report all suspected or reported violations to the County and the Federal awarding agency.

- (1) 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) The contractor shall insert into any subcontracts the clause above and such other clauses as may be appropriate, as well as a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all of these contract clauses.
- (3) 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

(F) Contract Work Hours and Safety Standards. If the contract value is in excess of \$100,000, the contractor shall compute the wages of every mechanic and laborer on the basis of a standard work week of 40 hours. Work in excess of the standard work week is permissible provided that the worker is compensated at a rate of not less than one and a half times the basic rate of pay for all hours worked in excess of 40 hours in the work week. The requirements of 40 U.S.C. 3704 are applicable to construction work and provide that no laborer or mechanic must be required to work in surroundings or under working conditions which are unsanitary, hazardous or dangerous. These requirements do not apply to the purchases of supplies or materials or articles ordinarily available on the open market, or contracts for transportation or transmission of intelligence. When required the Contractor must also comply with the following:

(1) Overtime requirements. No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such 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 \$31 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 County and the Contractor 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.

(G) Rights to Inventions Made Under a Contract or Agreement. If the Federal award meets the definition of “funding agreement” under 37 CFR § 401.2 (a) and the County wishes to enter into a contract with a small business firm or nonprofit organization regarding the substitution of parties, assignment or performance of experimental, developmental, or research work under that “funding agreement,” the Contract must comply with the requirements of 37 CFR Part 401, “Rights to Inventions Made by Nonprofit Organizations and Small Business Firms Under Government Grants, Contracts and Cooperative Agreements,” and any implementing regulations issued by the awarding agency.

(H) Clean Air Act and the Federal Water Pollution Control Act. If the contract value is in excess of \$150,000 the Contractor agrees to comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act (42 U.S.C. 7401–7671q) and the Federal Water Pollution Control Act as amended (33 U.S.C. 1251–1387). Contractor shall report violations to the Federal awarding agency, the Regional Office of the Environmental Protection Agency (“EPA”), and the County.

(1) Clean Air Act:

(a) The 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.

(b) The contractor agrees to report each violation to the County and understands and agrees that the County will, in turn, report each violation as required to assure notification to the State (if applicable), Federal Emergency Management Agency, and the appropriate Environmental Protection Agency Regional Office.

(c) The contractor agrees to include these requirements in each subcontract exceeding \$150,000 financed in whole or in part with Federal assistance provided by FEMA.

(2) Federal Water Pollution Control Act:

(a) The 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.

(b) The contractor agrees to report each violation to the County and understands and agrees that the County will, in turn, report each violation as required to assure notification to the State (if applicable), Federal Emergency Management Agency, and the appropriate Environmental Protection Agency Regional Office.

(c) The contractor agrees to include these requirements in each subcontract exceeding \$150,000 financed in whole or in part with Federal assistance provided by FEMA.

(I) Suspension and Debarment. No contract may be awarded to any party listed on the government-wide exclusions in the System for Award Management (“SAM”). contractor hereby warrants and certifies that it is not listed on SAM and the contractor is not debarred, suspended, or otherwise ineligible to enter into this contract. The contractor further acknowledges that:

(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) The 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 County. 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 the County, the Federal Government may pursue available remedies, including but not limited to suspension and/or debarment.

(4) The 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 throughout the Contract and any warranty period. The Contractor further agrees to include a provision requiring such compliance in its lower tier covered transactions.

(J) Byrd Anti-Lobbying Amendment. Contractors who apply or bid for an award of \$100,000 or more shall file the required certification. 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 Contractor, who in turn will forward the certification(s) to the County.

(K) Procurement of Recovered Materials. Section 6002 of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act. See 2 C.F.R. Part 200, Appendix II(J); and 2 C.F.R. § 200.322. 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 competitively within a timeframe providing for compliance with the contract performance schedule; meeting contract performance requirements; or at a reasonable price. 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>. The contractor also agrees to comply with all other applicable requirements of Section 6002 of the Solid Waste Disposal Act.

(L) Prohibition on Certain Telecommunications and Video Surveillance Services or Equipment. In performance of the contract, the contractor is prohibited from obligating or expending funds to:

(1) Procure or obtain;
(2) Extend or renew a contract to procure or obtain; or
(3) Enter into a contract (or extend or renew a contract) to procure or obtain equipment, services, or systems that uses covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system. As described in Public Law 115–232, section 889, covered telecommunications equipment is telecommunications equipment produced by Huawei Technologies Company or ZTE Corporation (or any subsidiary or affiliate of such entities).

(a) For the purpose of public safety, security of government facilities, physical security surveillance of critical infrastructure, and other national security purposes, video surveillance and telecommunications equipment produced by Hytera Communications Corporation, Hangzhou Hikvision Digital Technology Company, or Dahua Technology Company (or any subsidiary or affiliate of such entities).

(b) Telecommunications or video surveillance services provided by such entities or using such equipment.

(c) Telecommunications or video surveillance equipment or services produced or provided by an entity that the Secretary of Defense, in consultation with the Director of the National Intelligence or the Director of the Federal Bureau of Investigation, reasonably believes to be an entity owned or controlled by, or otherwise connected to, the government of a covered foreign country.

In implementing the prohibition under Public Law 115–232, section 889, subsection (f), paragraph (1), heads of executive agencies administering loan, grant, or subsidy programs shall prioritize available funding and technical support to assist affected businesses, institutions and organizations as is reasonably necessary for those affected entities to transition from covered communications equipment and services, to procure replacement equipment and services, and to ensure that communications service to users and customers is sustained.

(M) Domestic Preferences Procurements. As appropriate and to the extent consistent with law, the contractor should, to the greatest extent practicable under a Federal award, provide a preference for the purchase, acquisition, or use of goods, products, or materials produced in the United States (including but not limited to iron, aluminum, steel, cement, and other manufactured products).

For purposes of this section:

(1) "Produced in the United States" means, for iron and steel products, that all manufacturing processes, from the initial melting stage through the application of coatings, occurred in the United States.

(2) "Manufactured products" means items and construction materials composed in whole or in part of non-ferrous metals such as aluminum; plastics and polymer-based products such as polyvinyl chloride pipe; aggregates such as concrete; glass, including optical fiber; and lumber.

(N) Changes to the Contract. Contractor is directed to Section 1, of the contract and the GT&Cs in its entirety for as those relate to the cost of a change, modification, amendment, change order, or constructive change which must be allowable and allocable within the scope of its grant or cooperative agreement and reasonable for the completion of project scope.

(O) Access to Records. The following access to records requirements apply to this contract:

(1) The Contractor agrees to provide the County, the FEMA Administrator, the Comptroller General of the United States, or any of their authorized representatives access to any books, documents, papers, and records of the Contractor which are directly pertinent to this contract for the purposes of making audits, examinations, excerpts, and transcriptions.

(2) The Contractor agrees to permit any of the foregoing parties to reproduce by any means whatsoever or to copy excerpts and transcriptions as reasonably needed.

(3) The Contractor agrees to provide the FEMA Administrator or his authorized representatives access to construction or other work sites pertaining to the work being completed under the contract.

(4) In compliance with the Disaster Recovery Act of 2018, the County and the Contractor acknowledge and agree that no language in this contract is intended to prohibit audits or internal reviews by the FEMA Administrator or the Comptroller General of the United States.

(P) DHS Seal, Logo, and Flags. The contractor shall not use the DHS seal(s), logos, crests, or reproductions of flags or likenesses of DHS agency officials without specific FEMA pre-approval.

(Q) FEMA Financial Assistance. The contractor acknowledges that this contract is funded partially or fully through financial assistance provided by FEMA. The contractor agrees to comply with all applicable federal law, regulations, executive orders, FEMA policies, procedures, and directives.

(R) Federal Obligations and Liabilities. The contractor acknowledges that the Federal Government is not a party to this contract and is not subject to any obligations or liabilities created hereunder.

(S) Remedies for False Claims and Statements. The contractor acknowledges that 31 U.S.C. Chapter 38 (Administrative Remedies for False Claims and Statements) applies to its actions pertaining to this contract.

(T) Policy and Conservation Act. Contractor shall comply with applicable standards and policies relating to energy efficiency which are contained in the state energy conservation plan issued in compliance with the Energy Policy and Conservation Act (42 U.S.C. 6201).

(U) Contract Oversight. Pursuant to CFR §200.318, County will monitor and manage the day-to-day operations and activities to assure compliance with applicable Federal requirements and contract terms, conditions, and specifications.

(V) Affirmative Socioeconomic Steps: If subcontractors are to be let, the prime contractor is required to take all necessary steps identified in 2 C.F.R. § 200.321(b)(1)-(5) to ensure that small and minority businesses, women's business enterprises, and labor surplus area firms are used when possible.

(W) License and Delivery of Works Subject to Copyright and Data Rights: The contractor grants the COUNTY, a paid-up, royalty-free, nonexclusive, irrevocable, worldwide license in data first produces in the performance of this contract to reproduce, publish, or otherwise use, including prepare derivative works, distribute copies to the public, and perform publicly and publicly display such data. For data required by the contract but not first produced in the performance of this contract, the Contractor will identify such data and grant to the COUNTY or acquires on its behalf a license of the same scope as for date first produced in the performance of this contract. Data as used herein, shall include any work subject to copyright under 17 U.S.C. § 102, for example, and written reports or literary works, software and/or course code, music, choreography, pictures or images, graphics, sculptures, videos, motion pictures or other audiovisual works, sound and/or video recordings, and architectural works. Upon or before the completion of this contract, the Contractor will deliver to the COUNTY data first produces in the performance of this contract and data required by the contract but not first produced in the performance of this contract in formats acceptable to the COUNTY.

(X) Mandatory Purchase of Hawaii Products Inapplicable. Pursuant to HRS 103D-1002(i)(1), requirements related to the mandatory purchase of Hawaii Products shall not apply where doing so would disqualify the County from receiving federal funds or aid. 2 C.F.R. § 200.319(c) specifically prohibits the use of “statutorily or administratively imposed state, local, or tribal geographical preferences in the evaluation of bids or proposals” and as such, the above referenced provisions shall not apply and will not be enforced by the County.

Anti-Lobbying Certification

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. § 3801 et seq., apply to this certification and disclosure, if any.

By _____
(Signature)

(Print Name)

Date _____

CONTRACT NO. C[Contract No.]

PERFORMANCE BOND WITH SURETY

BOND NO. _____

KNOW TO ALL BY THESE PRESENTS:

That [CONTRACTOR NAME], a [Hawaii/Other] [corporation/limited liability company/nonprofit company/etc.], [dba CONTRACTOR DBA], whose mailing address is [Contractor's Mailing Address], as Contractor, hereinafter called "Principal," and _____, as surety, hereinafter called "Surety," a corporation authorized to transact business as a surety in the State of Hawaii, are held and firmly bound unto the COUNTY OF MAUI, a political subdivision of the State of Hawaii, Wailuku, Maui, Hawaii, its successors and assigns, hereinafter called "Obligee" in the amount of \$0.00 as performance bond, (being \$0.00 in the amount of one hundred percent (100%) of the contract price as required by Section 103D-324, Hawaii Revised Statutes), lawful money of the United States of America, for the payment of which to the said Obligee, well and truly made, Principal and Surety bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the above-bound Principal has signed a contract with Obligee dated _____, for the project entitled "[Name of Project]", identified under [IFB/RFP/Project/Job No.], hereinafter called "Contract," which Contract is incorporated herein by reference and made a part hereof.

NOW THEREFORE, the condition of this obligation is such that:

If the Principal shall promptly and faithfully perform, and fully complete the Contract in strict accordance with the terms of the Contract as said Contract may be modified or amended from time to time; then this obligation shall be void; otherwise to remain in full force and effect.

Surety to this bond hereby stipulates and agrees that no changes, extensions of time, alterations, or additions to the terms of the Contract, including the work to be performed thereunder, and the specifications or drawings accompanying same, shall in any way affect its obligation on this bond, and it does hereby waive notice of any such changes, extensions of time, alterations, or additions, and agrees that they shall become part of the Contract.

In the event of Default by the Principal, of the obligations under the Contract, then after written Notice of Default from the Obligee to the Surety and the Principal and subject to the limitation of the penal sum of this bond, Surety shall remedy the Default, or take over the work to be performed under the Contract and complete such work, or pay moneys to the Obligee in satisfaction of the surety's performance obligation on this bond.

Signed this _____ day of _____, 20____.

[EXECUTION PAGES TO FOLLOW]

CONTRACT NO. C[Contract No.]

PRINCIPAL EXECUTION PAGE

PRINCIPAL:

[CONTRACTOR NAME]

By _____
(Signature)

(Print Name)

Its _____
(Title)

Date _____

[THE REMAINDER OF THIS PAGE IS INTENTIONALLY LEFT BLANK]

CONTRACT NO. C[Contract No.]

STATE OF _____)
) SS.
COUNTY OF _____)

On this ____ day of _____, 20____, before me personally appeared _____, to me personally known, who, being by me duly sworn or affirmed, did say that such person executed the foregoing instrument as the free act and deed of such person, and if applicable, in the capacity shown, having been duly authorized to execute such instrument in such capacity.

IN WITNESS WHEREOF, I have hereunto set my hand and official seal.

[Stamp or Seal]

Notary Public, State of _____

Print name: _____

My commission expires: _____

NOTARY PUBLIC CERTIFICATION

Doc. Date:	_____	No. of Pages:	_____
Notary Name:	_____	Judicial Circuit:	_____
Doc. Description:	Performance Bond with Surety		
Contract No. [Contract Number]	_____		
_____		[Stamp or Seal]	

Notary Signature:	_____		
Date:	_____		

CONTRACT NO. C[Contract No.]

SURETY EXECUTION PAGE

SURETY:

By _____
(Signature)

(Print Name)

Its _____
(Title)

Date _____

[THE REMAINDER OF THIS PAGE IS INTENTIONALLY LEFT BLANK]

CONTRACT NO. C[Contract No.]

STATE OF _____)
) SS.
COUNTY OF _____)

On this ____ day of _____, 20____, before me personally appeared _____, to me personally known, who, being by me duly sworn or affirmed, did say that such person executed the foregoing instrument as the free act and deed of such person, and if applicable, in the capacity shown, having been duly authorized to execute such instrument in such capacity.

IN WITNESS WHEREOF, I have hereunto set my hand and official seal.

[Stamp or Seal]

Notary Public, State of _____

Print name: _____

My commission expires: _____

NOTARY PUBLIC CERTIFICATION

Doc. Date:	_____	No. of Pages:	_____
Notary Name:	_____	Judicial Circuit:	_____
Doc. Description:	Performance Bond with Surety,		
Contract No. [Contract Number]	_____	[Stamp or Seal] _____	
Notary Signature:	_____		
Date:	_____		

CONTRACT NO. C[Contract No.]

PAYMENT BOND WITH SURETY

BOND NO. _____

KNOW TO ALL BY THESE PRESENTS

That we, [CONTRACTOR NAME], a [Hawaii/Other] [corporation/limited liability company/nonprofit company/etc.], [dba CONTRACTOR DBA], whose mailing address is [Contractor's Mailing Address], as Contractor, hereinafter called "Principal," and _____, as surety, hereinafter called "Surety", a corporation authorized to transact business as a surety in the State of Hawaii, are held and firmly bound unto the COUNTY OF MAUI, a political subdivision of the State of Hawaii, Wailuku, Hawaii, its successors and assigns, as Obligee, hereinafter called "Obligee," in the amount of \$0.00 as payment bond (being \$0.00 in the amount of one hundred percent (100%) of the contract price as required by Section 103D-324, Hawaii Revised Statutes), lawful money of the United States of America, for the payment of which to the said Obligee, well and truly made, Principal and Surety bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, above-bound Principal has signed a contract with the Obligee dated _____ for the project entitled "[Name of Project]", identified under [IFB/RFP/Project/Job No.], hereinafter called "Contract," which Contract is incorporated herein by reference and made a part hereof.

NOW THEREFORE, the condition of this obligation is such that if the Principal shall promptly make payment to any Claimant, as hereinafter defined, for all labor and materials supplied to the Principal for the use in the performance of the Contract, then this obligation shall be void; otherwise to remain in full force and effect.

1. Surety to this bond hereby stipulates and agrees that no charges, extensions of time, alterations, or additions to the terms of the Contract, including the work to be performed thereunder, and the specifications or drawing accompanying same, shall in any way affect its obligation on this bond, and it does hereby waive notice of any such changes, extensions of time, alterations, or additions, and agrees that they shall become part of the Contract.

2. A "Claimant" shall be defined herein as any person who has furnished labor or materials to the principal for the work provided in the Contract.

Every Claimant who has not been paid amounts due for labor and materials furnished for work provided in the Contract may institute an action against the Principal and its Surety on this bond at the time and in the manner prescribed in Section 103D-324, Hawaii Revised Statutes, and have the rights and claims adjudicated in the action, and judgment rendered thereon; subject to the Obligee's priority in this bond. If the full amount of the liability of the Surety on this bond is insufficient to pay the full amount of the claims, then after paying the full amount due the Obligee, the remainder shall be distributed pro rata among the claimants.

Signed this _____ day of _____, 20_____.
Ver. 9/11/2023

[EXECUTION PAGES TO FOLLOW]

CONTRACT NO. C[Contract No.]

PRINCIPAL EXECUTION PAGE

PRINCIPAL:

[CONTRACTOR NAME]

By _____
(Signature)

(Print Name)

Its _____
(Title)

Date _____

[THE REMAINDER OF THIS PAGE IS INTENTIONALLY LEFT BLANK]

CONTRACT NO. C[Contract No.]

STATE OF _____)
) SS.
COUNTY OF _____)

On this ____ day of _____, 20____, before me personally appeared _____, to me personally known, who, being by me duly sworn or affirmed, did say that such person executed the foregoing instrument as the free act and deed of such person, and if applicable, in the capacity shown, having been duly authorized to execute such instrument in such capacity.

IN WITNESS WHEREOF, I have hereunto set my hand and official seal.

[Stamp or Seal]

Notary Public, State of _____

Print name: _____

My commission expires: _____

NOTARY PUBLIC CERTIFICATION	
Doc. Date:	No. of Pages:
Notary Name:	Judicial Circuit:
Doc. Description:	Payment Bond with Surety
Contract No. [Contract Number]	[Stamp or Seal]
Notary Signature:	
Date:	

CONTRACT NO. C[Contract No.]

SURETY EXECUTION PAGE

SURETY:

By _____
(Signature)

(Print Name)

Its _____
(Title)

Date _____

[THE REMAINDER OF THIS PAGE IS INTENTIONALLY LEFT BLANK]

CONTRACT NO. C[Contract No.]

STATE OF _____)
) SS.
COUNTY OF _____)

On this ____ day of _____, 20____, before me personally appeared _____, to me personally known, who, being by me duly sworn or affirmed, did say that such person executed the foregoing instrument as the free act and deed of such person, and if applicable, in the capacity shown, having been duly authorized to execute such instrument in such capacity.

IN WITNESS WHEREOF, I have hereunto set my hand and official seal.

[Stamp or Seal]

Notary Public, State of _____

Print name: _____

My commission expires: _____

NOTARY PUBLIC CERTIFICATION	
Doc. Date:	No. of Pages:
Notary Name:	Judicial Circuit:
Doc. Description:	Payment Bond with Surety,
Contract No. [Contract Number]	
	[Stamp or Seal]
Notary Signature:	
Date:	

SECTION 00800

SUPPLEMENTARY CONDITIONS

PART 1 – GENERAL

1.01 ABNORMAL WEATHER CONDITIONS

A rain, windstorm, high water, or other natural phenomenon for the specific locality of the work, which might reasonably have been anticipated from historical records of the general locality of the work, shall not be construed as abnormal. It is hereby agreed that rainfall greater than the following cannot be reasonably anticipated:

- A. Daily rainfall equal to, or greater than, **ten (10) inches** during a month when the monthly rainfall exceeds the normal monthly average by **fifteen percent (15%)** or more.
- B. Daily rainfall equal to, or greater than, **six (6) inches** at any time.

Rainfall data shall be assumed to be the same as reported on the National Weather Service website for the area at or nearest to the project site.

1.02 AMENDMENTS TO SECTION 00710 - GENERAL TERMS AND CONDITIONS

Section 00710 – General Terms and Conditions are amended as follows:

6.20 VALUE ENGINEERING

Revise and replace Paragraph 6.20(j) with the following:

“An equitable adjustment shall be made in the contract price so that the Contractor and the County each share a 50 % portion of the realized cost reduction”.

6.21 PLANS TO BE FURNISHED BY THE CONTRACTOR

Add the following to the end of Paragraph 6.21(c):

“The contractor may also submit electronic drawings, provided they are in portable document format (“PDF”) in the same size and scale as the original document.”

7.3 MONTHLY PROGRESS PAYMENTS

Add the following to the end of Paragraph 7.3(a):

The Contractor shall submit **four (4) hard copies OR one (1) electronically-signed PDF via email** of the Monthly Progress Payment

requests to the Department of Environmental Management, Wastewater Reclamation Division; attention to the project manager. Each copy shall consist of:

1. **Progress and Payment Estimate Report Form** from Section 01999, with at least **one (1)** of the copies signed in original by the Contractor's authorized officer.
2. **Spreadsheet** showing a line-item breakdown of each of the different tasks or activities which are part of the project. Each line item will show the (1) contract amount for each item, (2) item percent completed to date, (3) item amount billed to date, (4) previous percentage completed, (5) previous amount billed, (6) current percent of work, and (7) current amount billed.
3. **Act 68 of 2010 Compliance, Self Certification Form** from Section 01999. NOTE: If no progress payments are made for any month, the Contractor is still responsible to submit the certification on a monthly basis.

11.4 CHANGE ORDER WORK BY FORCE ACCOUNT

Add the following to the end of Paragraph 11.4(a):

- (d) A copy of the "**Change Order Work by Force Account**" calculation spreadsheet is included in Section 01999 – Reference Forms.

2.00 ACT 68 OF 2010, EMPLOYMENT OF STATE RESIDENTS ON CONSTRUCTION PROCUREMENT CONTRACTS

Bidders are advised of the applicability of Act 68, SB 2840, Employment of State Residents on Construction Procurement Contracts, (2010) ("Act 68"). Act 68 requires the awarded contractor to ensure that Hawaii Residents (as defined in the Act) compose not less than **eighty percent (80%)** of the workforce employed to perform the contract. This requirement shall also apply to subcontracts of \$50,000 or more in connection with any construction contract procured under HRS Chapter 103D, but does not apply to procurements made pursuant to HRS §103D-304 (professional services), HRS § 103D-305 (small purchases), or if there is a conflict with any federal law as further detailed below under "Conflict with Federal Law."

Definitions for terms used in Act 68 (2010)

"Contract" means contracts for construction under chapter 103D, HRS.

"Contractor" has the same meaning as in section 103D-104, HRS; provided that contractor includes a subcontractor where applicable.

"Construction" has the same meaning as in section 103D-104, HRS.

"Procurement Officer" has the same meaning as in section 103D-104, HRS.

"Resident" means a person who is physically present in the state at the time the person claims to have established the person's domicile in the state and shows the person's intent is to make Hawaii the person's primary residence.

"Shortage trade" means a construction trade in which there is a shortage of Hawaii residents qualified to work in the trade.

Requirements of Contractor

The contractor awarded this contract shall ensure that Hawaii Residents compose not less than eighty per cent of the workforce employed to perform this Contract, calculated as follows:

The eighty per cent requirement shall be determined by dividing the total number of hours worked on a contract by Residents by the total number of hours worked by all employees of the Contractor in the performance of the Contract. Hours worked for any subcontractor of the contractor shall count towards the calculation for purposes of this subsection. The hours worked by employees within shortage trades, as determined by the Department of Labor and Industrial Relations, shall not be included in the calculations for purposes of this subsection.

This requirement shall be applicable during the entire duration of this Contract. **A notarized Certification for Employment of State Residents on Construction Procurement Contracts shall be submitted on a monthly basis with your progress payments. If no progress payments are made for any month, the Contractor is still responsible to submit the certification on a monthly basis.**

Penalties

Failure to comply with this requirement shall be subject to any of the following sanctions:

- (1) Temporary suspension of work on the project until the Contractor or subcontractor complies with Act 68;
- (2) Withholding of payment on the Contract or subcontract, as applicable, until the Contractor or subcontractor complies with Act 68;
- (3) Permanent disqualification of the Contractor or subcontractor from any further work on the project;
- (4) Recovery by the County of any moneys expended on the Contract or subcontract, as applicable; or
- (5) Proceedings for debarment or suspension of the Contractor or subcontractor under section 103D-702.

Conflict with federal law

Act 68 shall not apply if the application of the Act is in conflict with any federal law, or if application of Act 68 will disqualify the County from receiving federal funds or aid.

3.00 PROMPT PAYMENT BY CONTRACTORS TO SUBCONTRACTORS (ACT 291)

Bidders are advised of the applicability of Act 291, SLH 2006, the Prompt Payment Act which became effective on July 1, 2007 for contracts that are executed on or after July 11, 2007. The act enables prompt payment for government work of general contractors, subcontractors, and material suppliers. It achieves a reasonable balance between incentive for prompt payment and protecting the interests of general contractors, subcontractors, material suppliers, and government agencies. All government agencies are responsible for implementation.

A copy of Act 291 is available at:

http://www.capitol.hawaii.gov/session2006/bills/HB3036_cd1.htm.

All applicable references contained in the General Conditions, General Instruction to Bidders, special provisions and bid documents are superseded by this Act.

4.00 CAMPAIGN CONTRIBUTIONS SECTION 11-205.5 HRS

Contractors are hereby notified of the applicability of Section 11-205.5 HRS, which states that campaign contributions are prohibited from specified County government contractors during the term of the contract if the contractors are paid with funds appropriated by a legislative body.

END OF SECTION

SECTION 01010
SUMMARY OF WORK

PART 1 - GENERAL

1.01 AUTHORIZATION

- A. Acting on behalf of the County of Maui, Hawaii, the Department of Environmental Management has authorized this project entitled "**LIPOA WASTEWATER PUMP STATION, COUNTY JOB NO. WW19-02**".

1.02 PROJECT LOCATION

- A. The work covered under this contract is located at the park adjacent to the Kihei Aquatic Center, Kihei, Maui, Hawaii (TMK2-2-024:23).

1.03 EXISTING FACILITIES

- A. The work will take place in the park adjacent to the Kihei Aquatic Center. The Contractor is advised of the presence within the project limits of existing utilities (recycled water irrigation lines) and other improvements including but not limited to potable water lines, sewer lines, various underground power and telephone lines, storm drains, parking lots. All facilities and existing utilities shall remain in operation throughout the duration of the project.
- B. Access to the site shall remain open throughout the duration of the project. Temporary closure of roads, sidewalks, etc. shall be coordinated with the Construction Manager.
- C. When excavating, the Contractor shall be aware of all underground utilities and shall exercise extreme caution to prevent damage to existing utilities.

1.04 PROJECT PLANNING AND OBJECTIVES

- A. The objective of this project is to provide all the labor, equipment and materials necessary to construct the proposed improvements as described in the Construction Documents within the specified time of completion, while minimizing disruptions to the public.

1.05 PROJECT DESCRIPTION

- A. Work under this contract includes furnishing all labor, materials, equipment, and services required to construct the new Lipoa Wastewater Pump Station, consisting of the following major elements:
- Site work, including grubbing and clearing, grading, yard piping, and fencing.
 - Excavation work for the new wetwell.

- Construction of new wet well.
- Installation of wet well submersible pumps.
- Installation of new piping and valves.
- Connection of the pump station to the new gravity sewer and connection to the new effluent forcemain.
- Construction of odor control system.
- Construction of a new electrical building, including electrical equipment and panels.
- Installation of a new generator and abovegrade fuel tank.
- SCADA coordination.
- Installation of exterior lighting system for nighttime operations.
- Site paving and restoration.

1.06 CONSTRUCTION COORDINATION

- A. Lipoa Wastewater Pump Station is a new facility and can be constructed without having to ensure that flow is bypassed. However, coordination with the Contractor responsible for the influent and effluent forcemain work is critical and shall be coordinated with the Construction Manager.

1.07 SPECIAL CONDITIONS

- A. Normal work hours are **7:00 AM to 3:30 PM**, Monday through Friday, except on County Holidays. The Contractor shall be responsible for any costs incurred by the County of Maui as the result of work occurring outside regular hours, except in cases where the county specifically requires the Contractor to work outside regular hours.
- B. The existing facilities shall remain in continuous operation throughout the duration of this project. The Contractor will exercise extreme caution when working near all utilities so as to prevent disruptions, outages or sewage spills. The Contractor shall be responsible for all repair costs and DOH fines incurred by the County as a result of sewage spills caused by the Contractor.
- C. The Contractor will be required to submit a "**SITE SPECIFIC SPILL PREVENTION AND CONTROL PLAN**" ("**SSSPCP**") for review and approval prior to commencing work. The SSSPCP will detail the means and methods the Contractor will use to prevent and control spills. The SSSPCP shall be submitted at least **fourteen (14) calendar days** in advance to the WWRD for review and approval.
- D. The Construction Manager shall have the authority to stop work at any time if there is a risk of loss of equipment, injury, death, sewage spill or it becomes necessary to restore normal operations.

- E. All work areas shall be marked and barricaded in accordance with all OSHA/HIOSH regulations. All persons entering the marked construction zone shall wear hardhats, steel toes and all other Personal Protection Equipment ("PPE") required by OSHA/HIODH or by WWRD.

1.08 TIME OF COMPLETION

- A. The overall time of completion will be **540 CALENDAR DAYS** after Notice to Proceed (NTP) is issued.
- B. Liquidated damages shall be per Section 00300.

1.09 STAGING AND STORAGE AREA

- A. There is limited space available at the project site for long term storage and staging. The Contractor shall coordinate storage and staging with the Construction Manager.
- B. The Contractor is responsible for obtaining additional staging and storage area if required. The Contractor will not be allowed to stockpile or store equipment and/or material within the County Right of Way. This restriction applies to private property unless approved in writing by the Owner of the private owned parcel. It shall be the responsibility of the Contractor to negotiate the usage of property.
- C. The County will not be responsible for any theft or damage to Contractor's property that is stored and staged on County property.

PART 2 – PRODUCTS

(NOT USED)

PART 3 – EXECUTIONS

(NOT USED)

END OF SECTION

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SECTION 01014

WORK SEQUENCE

PART 1 - GENERAL

1.01 CONTINUITY OF OPERATIONS

- A. Lipoa Wastewater Pump Station (WWPS) is a new pump station that is not currently receiving any flow from Kihei WWPS #4 nor the gravity sewer system. However in order to allow for proper commissioning, coordination between the LIPOA WWPS CONTRACTOR and the CONTRACTOR for the influent gravity line and the effluent forcemain will be necessary.
- B. The Contractor shall coordinate the work with the Construction Manager to minimize disruptions to utility services and minimize the extent and duration of time temporary bypass facilities are required. The Contractor shall provide at least 14 days' written notice to the Construction Manager prior to any desired shutdown activity or other work that would disrupt utility services for review and acceptance. Proposed activity shall not proceed without the Construction Manager's acceptance.
- C. The Contractor's operations shall not impact access to Kihei Aquatic Center or to the surrounding community.
- D. Wastewater Spills: In the event of accidental wastewater spills or other unauthorized discharges due to the Contractor's operations, the County shall immediately be entitled to employ others or use its own forces to stop the incident, without giving notice to the Contractor.
- E. Fines or penalties imposed on the County, costs incurred by the County for cleanup of the spill site or rehabilitation of damaged equipment, and legal fees and other expenses to the County, as a direct or indirect result of any wastewater spills caused by the actions of the Contractor, his employees or subcontractors, shall be borne in full by the Contractor.
- F. The Contractor shall report wastewater spills immediately to the Construction Manager to allow for timely reporting of the wastewater spill to appropriate authorities and mitigation of spill impacts. The Contractor shall obtain from the Construction Manager current contact information for reporting of spills during both normal work hours and nonwork hours. The Contractor shall obtain a current official copy of the "Protocol for Sewage Spills" from the Wastewater Branch of the State Department of Health (Telephone No. 586-4294) and be familiar with wastewater spill reporting requirements.

PART 2 - METHODS AND MATERIALS

2.01 GENERAL

- A. The Contractor shall schedule the work such that minimal disruption occurs at any given time. All connections or modifications which disrupt normal operation of any process or function shall be performed during the nighttime low flow period unless a specific written variance to this requirement is issued by the Construction Manager. WWPS shutdowns shall be in accordance with the provisions hereinafter, unless otherwise approved by the Construction Manager. If the Contractor decides to work on a County Holiday, the Contractor will be held responsible for all subsequent Wastewater Reclamation Division costs, including Overtime Pay.
- B. Any work outside of the normal work hours shall be scheduled fourteen (14) calendar days in advance and shall be accepted in writing by the Construction Manager.

2.02 WORK SEQUENCE AND CONSTRUCTION SCHEDULE

- A. General: The work sequence described below is written to allow minimum interruption to sewer operations and minimize duration of temporary bypassing. This section describes one method to accomplish the required work. The construction techniques or sequences herein are presented to illustrate the principles involved. Alternate techniques or sequences may be acceptable subject to review by the Construction Manager. Short-term disruptions may be required that are not itemized herein. The construction sequence outlined herein is not all inclusive and does not cover all work required by the Project Manual. The Contractor is responsible for the coordination of all required work involving all trades. No extra payment will be approved for any disruptions not described herein, nor will extra payment be approved should the construction techniques or sequences described herein, or those subsequently chosen by the Contractor, prove infeasible and/or more costly than alternative approaches. The use of any construction techniques or schedules described herein shall not relieve the Contractor of responsibility for detailed planning, coordination, scheduling, and other responsibilities described in Section 00710-6, and liabilities described in Section 00710-4.
- B. Work shall be performed during regular work hours specified in Section 01010 and Section 01014, unless otherwise approved. Work outside of normal working hours, required for special demolition and construction work during low flow periods and/or to minimize the duration of wastewater bypassing, shall be approved by the Construction Manager on a cases specific basis.

C. WORK SEQUENCE FOR LIPOA WWPS:

1. Contractor shall provide a schedule for construction clearly indicating when construction shall start and is expected to be completed to the Construction Manager in accordance with Section 01310.
2. Construct improvements as shown on plans and as specified.
3. Contractor may test the pumps, generator and other systems by installing a temporary line that reroutes the pump station's effluent forcemain downstream of the flow meter back to the influent manhole. Contractor to provide potable water for use during pump testing. Recycled water may be used upon approval by the Construction Manager.

Other work, which can generally be completed independent of the work indicated above, shall be properly coordinated to facilitate construction and operation of the pump station.

D. Typical Sequence for All Major Tasks: The following sequence items, relating to task coordination and safety, are applicable to all major project tasks. The Contractor will:

1. Prior to Construction:
 - a. Obtain all necessary permits to perform work within the County of Maui Road Way.
 - b. Coordinate the work with the Construction Manager and all private owners.
 - c. Erect all required environmental, safety and traffic controls (silt fences, hay bales, storm drain socks, dust fences, temporary fences, barricades, traffic cones, traffic barriers, electronic signage, etc.).
 - d. Install appropriate BMPs.
2. During Construction:
 - a. Maintain Environmental, Safety, and Traffic Controls as required.
 - b. An archeologist will be onsite, provided by the Contractor. In case archeological artifacts or human remains are found, work will stop until the archaeologist can recover, protect, and document the findings.
 - c. Cover all excavations overnight with backfill, cold asphalt mix, or nonskid steel plates. Provide temporary barriers and barricades.
3. After Construction:
 - a. Remove all construction equipment and materials.
 - b. Remove all temporary barricades, environmental, safety, and traffic controls, restore all existing improvements and restore public access.

PART 3 – EXECUTION

(NOT USED)

END OF SECTION

SECTION 01015

CONTRACTOR'S USE OF PREMISES

PART 1 – GENERAL

1.01 DESCRIPTION

- A. The following entities are responsible for the overall operation and maintenance of the existing site:
 1. County of Maui, Department of Parks and Recreation
 2. Hawaiian Electric Company
- B. All facilities and utilities shall remain accessible to County personnel and Hawaiian Electric Company at all times for their normal operations, maintenance and repair. If in the course of the project, it becomes necessary for the Contractor to move his equipment and/or any materials included in the Work so the County's or HECO personnel may perform their duties, he shall do so promptly and place that equipment and/or material in an area which does not interfere with facility operations. The Contractor shall not adjust or operate serviceable or functioning equipment or systems except as specifically required by this Contract. The Contractor shall not use any existing system, except where specified, for construction purposes.
- C. The Contractor shall have sole responsibility for bypass pumping or other temporary facilities for the duration of construction unless directed otherwise by the Construction Manager.
- D. The Contractor shall notify the Construction Manager in writing two weeks in advance of the time it is necessary to take out of service any existing equipment or structure. The Contractor shall be responsible for providing any necessary temporary piping, pumping, power, and control facilities as are required to maintain continuous service except as otherwise specified.

PART 2 – PRODUCTS

(NOT USED)

PART 3 – EXECUTION

3.01 REQUIRED SERVICE OUTAGES

- A. The Contractor shall comply with the requirements of Section 01014,

“WORK SEQUENCE,” when taking equipment out of service, bypassing flows, or modifying the existing sewer system. The Contractor shall provide temporary piping, pumping, power, and control facilities as required to maintain continuous sewer operation, except as otherwise specified.

3.02 CONTRACTOR'S FACILITIES

- A. The Contractor's facilities shall be as specified in Section 01500.

END OF SECTION

SECTION 01016

MOBILIZATION AND DEMOBILIZATION

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Mobilization: The Contractor shall mobilize his construction equipment including materials and supplies for operation, make all necessary arrangements for equipment and material storage and staging areas, and assemble any equipment at the site as soon as possible after receipt of **Notice to Proceed** (NTP).
- B. Demobilization: The Contractor shall demobilize and transport his construction equipment including materials and supplies off the site as soon as possible after construction is completed.
- C. Demobilization shall include all cleanup required under this Contract and as directed by the Construction Manager. Demobilization and final cleanup shall be completed prior to final acceptance.
- D. Liaison During Construction: The Contractor shall be responsible to receive and address complaints and comments from the public as they arise during the construction in an expedient and professional manner. The Contractor shall have local knowledge of the neighborhood being affected and shall maintain effective lines of communication at all times between the Contractor and local residents during a dispute. The Contractor will file a written report for each complaint recording the specific details of the complaint, and the steps taken to resolve the matter. Copies of the report will be submitted to the Construction Manager and the Contractor's project file.

PART 2 – PRODUCTS

(NOT USED)

PART 3 - EXECUTION

(NOT USED)

END OF SECTION

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SECTION 01020

PERMITS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The Contractor will obtain and pay for all permits required for this project. The Contractor shall comply with conditions of all permits issued by utility companies and regulatory agencies in connection with all work under the contract. Unless otherwise specified in the Contract, two (2) copies of all permits required for the Project shall be submitted to the Construction Manager.

1.02 COST OF PERMITS

- A. Contractor shall pay all charges imposed by utility companies, public agencies, or regulatory agencies, resulting from all permits other than filing fees for permits already obtained by the County. Contractor shall be responsible for conducting all tests and furnishing all materials, equipment, and labor necessary for compliance with all permits. The required permits may include, but not limited, to the following:
1. County ROW construction permit.
 2. County Building Permit
 3. Dumping charges.
 4. Excavation permit.
 5. Chapter 55 Water Pollution Control, Hawaii Administrative Rules, Title 11, State Department of Health, for discharges of stormwater associated with construction, discharges of hydraulic testing waters, discharges associated with construction dewater activities, etc.
 6. Community noise permit.
 7. Construction dewatering permit.
 8. Air permit.

END OF SECTION

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SECTION 01040

COORDINATION WITH OPERATION OF EXISTING FACILITIES

PART 1 - GENERAL

1.01 DESCRIPTION

A. SCOPE OF WORK:

This project will result in the rerouting of flows from the existing Kihei Wastewater Pump Station (WWPS) #4 to the new Lipoa Wastewater Pump Station. While the construction of the new Wastewater Pump Station can be conducted independently of the operation of WWPS #4, commissioning of the new station will require close coordination with the Contractor responsible for the construction of the influent wastewater forcemain and gravity sewer and the new effluent wastewater forcemain.

The Contractor shall schedule and conduct his work so as to minimize interference with routine operations and maintenance. It is the intent of this Contract that the construction activity, insofar as possible, shall not interfere with the operation of the existing systems. The Contractor shall be responsible for coordinating and scheduling the Work in such a sequence that the existing and proposed facilities will function properly with no disruptions except as specified in Section 01014, "WORK SEQUENCE."

B. OPERATIONS WORK PLAN:

Contractor shall submit a written Work Plan for review and approval **fourteen (14) calendar days** in advance of the time when construction operations will require temporary service or bypassing. The plan shall describe the Contractor's method for maintaining service, the length of time required to complete work for the said operations. The work plan shall address each of the following coordination, planning, and scheduling activities:

1. Emergency procedures.
2. Temporary facilities.
3. Demolition Plan.
4. Connection of new and existing facilities.

C. COORDINATION WITH COUNTY:

Delays in the construction schedule due to failure of the Contractor to adequately coordinate the work with the Construction Manager sufficiently in advance of the work shall not be considered as cause for extension of the contract time. It shall be the Contractor's responsibility to continuously keep the Construction Manager informed of the construction schedule as the work progresses. **Submittal of the construction schedule required in Section 01310 shall not relieve the Contractor of the responsibility to coordinate the work with the Construction Manager nor give advance notifications as specified.**

1.02 PERFORMANCE REQUIREMENTS

A. GENERAL:

When modifications, additions, or connections to existing facilities are required, the Contractor shall schedule such activities with the Construction Manager. No part of the existing system shall be modified or removed unless authorized, in writing, by the Construction Manager. All interconnections between existing systems and new systems shall be made at the end of each work day.

1.03 QUALITY ASSURANCE

A. SUBMITTALS:

In accordance with specification Section 01300 and in addition to the requirements of that section, the following submittals shall be provided:

1. Operations Work Plan.
2. Drawings of proposed temporary facilities.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

(NOT USED)

END OF SECTION

SECTION 01046

DEMOLITION AND SALVAGE

PART 1 - GENERAL

1.01 DESCRIPTION

A. SCOPE OF WORK:

This section includes materials and equipment to be salvaged and returned to the County; or demolished and removed from the site as trash by the Contractor. The sequence in which systems can be worked on will be as specified in **Section 01014, “WORK SEQUENCE.”** Coordinate with the subcontractor and County for all materials required to be turned over to County.

Furnish all labor, material, equipment, and incidentals required to demolish, modify, or alter, existing facilities as shown or specified and as required for the installation of new mechanical, piping, and appurtenances.

B. PERFORMANCE REQUIREMENTS:

1. Existing Conditions: Contractor will visit the site and inspect the nature and condition of all facilities to be removed, partially removed, modified, or altered in any way prior to submittal of his Bid. No increase in cost or extension of Contract time will be considered for failure to know the conditions of the site and structures.
2. Demolition and Disposal: All other materials removed under the removal Work, including dismantled equipment and materials, piping, pumps, fittings, valves, machinery, gates, concrete equipment pads, miscellaneous and structural metals, masonry, carpentry and other construction debris are the property of the Contractor to be removed from the site as trash. Dispose trash and debris legally, off the site. Upon removal from site, Contractor has the rights of salvage of materials.

1.02 QUALITY ASSURANCE

A. PROTECTION OF EXISTING FACILITIES:

Protect existing structures and property of the County while proceeding with Work of this section and the entire Contract. All damage will be repaired at once to the satisfaction of the Construction Manager. All such repairs will be at the expense of the Contractor and no claims for additional payment will be accepted.

When removing materials or portions of existing structures and when making openings in walls, partitions, and roof the Contractor will provide barriers, dust screens, weatherproofing, and other protective devices so as not to damage the structures and contents beyond the limits necessary for the new Work, nor to damage the structures or contents by falling or flying debris nor to transfer any heavy shocks and vibrations to structures to remain. Do not use swinging weights to demolish structures.

PART 2 - MATERIALS AND METHODS

2.01 REPAIR AND RESTORATION

A. GENERAL:

The Contractor will alter or rework existing structures as shown and specified. Generally, when items of equipment and piping are removed, the areas and surfaces from which items were removed will be left with a neat appearance and finish compatible with surrounding areas, colors, and surfaces. Paint, sand, grout, sack, resurface, and other Work as necessary to comply with the above requirements. Prior to structural modifications, all surfaces will be subject to inspection by the Construction Manager. Colors will match existing colors as closely as possible. For replacement, repair or restoration of Work removed, comply with the specifications for the type of Work to be done.

B. PENETRATIONS:

Where holes in existing masonry or concrete are required to be sealed, unless otherwise specified, they will be sealed with cement mortar or concrete. The sides of the openings will be provided with keyed joints and will be suitably roughened to furnish a good bond and make a watertight joint. All loose or unsound material adjacent to the opening will be removed and, if necessary, replaced with new material. The method of placing the mortar seal will provide a suitable means of releasing entrapped air.

C. PIPING MODIFICATIONS:

Where necessary or required for the purpose of making piping connections, cut existing pipelines and provide suitable plugs, bulkheads, or other means to hold back the flow of water or other liquids, all as required in the performance of the Work under this Contract. The remaining open ends of all piping, valves, fittings, and appurtenances that are removed will be plugged with standard pipe plugs or closed with flanges so that there will be no leakage through the closure.

PART 3 - EXECUTION

3.01 GENERAL

A. CONTROL OF HAZARD AND NUISANCE CONDITIONS:

All demolition, removal salvage, and renovation Work will be conducted in a manner which will protect the environment, promote public health and safety, and preclude nuisance conditions, in strict conformance with the requirements of Sections 01060 "SAFETY AND HEALTH" and 01560 "ENVIRONMENTAL CONTROLS". In addition, enforce the following safety requirements:

1. No fires will be permitted on-site.
2. Post "No Smoking" signs in all interior spaces and in hazardous or confined spaces where dismantling operations are to be carried on. Strictly enforce "No Smoking" restrictions among all personnel employed on the Work.

B. CUTS:

Cuts in wood, concrete, masonry and other work will be made neatly and will not extend beyond the limit of indicated removal work.

C. GRADING AND BACKFILL:

All excavation made in connection with this item and all openings below permanent ground caused by the removal of a structure will be backfilled with suitable material and graded to match the proposed grading plan. That portion of the backfill which will support any portion of a roadbed, driveway, or structure will be backfilled and compacted in accordance with specification Section 02300, "EARTHWORK."

D. WEATHER PROTECTION:

Openings in exterior walls, or other elements providing weather protection, will not be started until temporary weatherproof enclosures are in place or can be put in place immediately after such removal.

END OF SECTION

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SECTION 01060

SAFETY AND HEALTH

PART 1 - GENERAL

1.01. GENERAL REQUIREMENTS:

- A. Portions of the existing facilities are exposed to raw, untreated wastewaters. The Contractor, in Section 00423, "CERTIFICATION OF BIDDER'S EXPERIENCE AND QUALIFICATIONS," certifies that he is experienced and qualified to anticipate and meet the safety and health requirements of this project.
- B. Workmen involved in the removal, renovation, or installation of equipment for the project may be exposed to infectious organisms in wastewater. The Contractor shall require his personnel to observe proper hygienic precautions. The Contractor shall provide for lunch areas away from process facilities and provide soap and potable water nearby for hand washing.
- C. Solvents, gasoline, and other hazardous materials enter the sewer system with incoming sewage, and, therefore, certain areas are hazardous to open flame, sparks, or unventilated occupancy. The Contractor shall take measures to assure his personnel observe proper safety precautions when working in these areas.

1.02. SAFETY AND HEALTH REGULATIONS:

- A. The Contractor shall comply with Safety and Health Regulations for Construction, promulgated by the Secretary of Labor under Section 107 of the Contract Work Hours and Safety Standards Act, as set forth in Title 29, C.F.R. Copies of these regulations may be obtained from the Labor Building, 14th and Constitution Avenue N.W., Washington, DC 20013.
- B. The Contractor shall also comply with the provisions of the Federal Occupational Safety and Health Act, as amended, and all state regulations relating to safety.

1.03. CONFINED SPACES:

- A. Confined spaces as defined by the National Institute for Occupational Safety and Health (NIOSH) include any "space which by design has limited openings for entry and exit; unfavorable natural ventilation which

- could contain or produce dangerous air contaminants; and which is not intended for continuous employee occupancy." Manholes, pump station wet wells, pump station drywells during certain stages of construction, and any other areas meeting the NIOSH definition shall be designated as confined spaces.
- B. Entrances to confined spaces shall be equipped with a warning sign designating the area as a confined space and indicating the need for proper entrance procedures. These areas shall be provided with forced draft ventilation to supply fresh air whenever workmen enter the space. All hazardous gas detection devices shall be provided by the Contractor for use in confined spaces. Workmen shall wear safety harnesses with lines anchored outside the confined space. One worker shall be stationed outside the confined space to observe activities inside the confined space and assist others or obtain help in the event of an emergency.
- C. All workers within the confined space area, including the outside observer, shall be trained, and be deemed competent in confined space entry safety procedures and methods.

1.04 QUALITY ASSURANCE

A. **SUBMITTALS:**

1. In accordance with specification Section 01300, "SUBMITTALS," and in addition to the requirements of that section, the following submittals shall be provided:

Confined Space Entry Certification	X
Electrical Work Training Certification	X
Safety Plan	X

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

(NOT USED)

END OF SECTION

SECTION 01071

ABBREVIATIONS AND STANDARD REFERENCES

PART 1 - GENERAL

1.01 ABBREVIATIONS

Abbreviations which are used in the project manual shall be as defined in ANSI Y1.1. Abbreviations used in the drawings are shown on the drawings in an abbreviations list.

1.02 STANDARD REFERENCES

Wherever used in the project manual, the following abbreviations will have the meanings listed:

AA	Aluminum Association Incorporated 818 Connecticut Avenue, N.W. Washington, D.C. 20006
AAMA	American Architectural Manufacturers Association 2700 River Road, Suite 118 Des Plaines, IL 60018
AASHTO	American Association of State Highway and Transportation Officials 444 North Capitol Street, N.W., Suite 225 Washington, DC 20001
ACI	American Concrete Institute P.O. Box 19150 Detroit, MI
AEIC	Association of Edison Illuminating Companies 51 East 42nd Street New York, NY 10017
AFBMA	Anti-Friction Bearing Manufacturer's Association 60 East 42nd Street New York, NY 10017

AGA	American Gas Association 8501 East Pleasant Valley Road Cleveland, OH 44131
AGMA	American Gear Manufacturer's Association 1330 Massachusetts Avenue, N.W. Washington, DC
AISC	American Institute of Steel Construction 101 Park Avenue New York, NY 10017
AISI	American Iron and Steel Institute 1000 16th Street, N.W. Washington D.C. 20036
AITC	American Institute of Timber Construction 333 West Hampden Avenue Englewood, CO 80110
AMCA	Air Movement and Control Association, Inc. 30 West University Drive Arlington Heights, IL 60004
ANSI	American National Standards Institute, Inc. 1430 Broadway New York, NY 10018
APA	American Plywood Association 1119 A Street Tacoma, WA 98401
API	American Petroleum Institute 1801 K Street N.W. Washington, DC 20006
ARI	Air-Conditioning and Refrigeration Institute 1814 North Fort Myer Drive Arlington, VA 22209
ASCE	American Society of Civil Engineers 345 East 47th Street New York, NY 10017

ASCII	American Standard Code for Information Interchange United States of America Standards Institute 10 East 40th Street New York, NY 10016
ASE	American Standard Safety Code for Elevators, Code Dumbwaiter and Escalators American National Standards Institute 1430 Broadway New York, NY 10018
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers United Engineering Center 345 East 47th Street New York, NY 10017
ASME	American Society of Mechanical Engineers 345 East 47th Street New York, NY 10017
ASTM	American Society for Testing and Materials 1916 Race Street Philadelphia, PA 19103
AWPA	American Wood Preservers Association 1625 Eye Street Washington, DC 20006
AWS	American Welding Society 2501 N.W. 7th Street Miami, FL 33125
AWWA	American Water Works Association 6666 West Quincy Avenue Denver, CO 80235
CBM	Certified Ballast Manufacturers 2120 Keith Building Cleveland, OH 44115

CMAA	Crane Manufacturers Association of America, Inc. (Formerly called: Overhead Electrical Crane Institute) (OECI) 1326 Freeport Road Pittsburgh, PA 15238
CRSI	Concrete Reinforcing Steel Institute 180 North La Salle Street Chicago, IL 60601
CSA	Canadian Standards Association 178 Rexdale Boulevard Rexdale, Ontario, M9W 1R3, Canada
DEMA	Diesel Engine Manufacturer's Association 122 East 42nd Street New York, NY 10017
DHI	Door Hardware Institute 7711 Old Springhouse Road McLean, VA 22102
EEI	Edison Electric Institute 90 Park Avenue New York, NY 10016
EIA	Electronic Industries Association 2001 Eye Street N.W. Washington, DC 20006
EJMA	Expansion Joint Manufacturer's Association 331 Madison Avenue New York, NY 10017
FEDSPEC	Federal Specifications General Services Administration Specification and Consumer Information Distribution Branch Washington Navy Yard, Bldg. 197 Washington, DC 20407
FEDSTDs	Federal Standards (see FEDSPECS)

FM	Factory Mutual Research 1151 Boston-Providence Turnpike Norwood, MA 02062
HEI	Heat Exchange Institute 122 East 42nd Street New York, NY 10017
HI	Hydraulic Institute 1230 Keith Building Cleveland, OH 44115
IAPMO	International Association of Plumbing and Mechanical Officials 5032 Alhambra Avenue Los Angeles, CA 90032
IBC	International Building Code Published by International Building Code
ICBO	International Conference of Building Officials 5360 South Workman Mill Road Whittier, CA 90601
ICEA	Insulated Cable Engineers Association P.O. Box P South Yarmouth, MA 02664
IEEE	Institute of Electrical and Electronics Engineers, Inc. 345 East 47th Street New York, NY 10017
IES	Illuminating Engineering Society c/o United Engineering Center 345 East 47th Street New York, NY 10017
ISA	Instrument Society of America 400 Stanwix Street Pittsburgh, PA 15222
JIC	Joint Industrial Council 7901 Westpark Drive McLean, VA 22101
MILSPEC	Military Specifications Naval Publications and Forms Center

	5801 Tabor Avenue Philadelphia, PA 19120
MSS	Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. 127 Park Street, N.E. Vienna, VA 22180
NAAMM	National Association of Architectural Metal Manufacturers 100 South Marion Street Oak Park, IL 60302
NACE	National Association of Corrosion Engineers P.O. Box 986 Katy, TX 77450
NEC	National Electric Code National Fire Protection Association 470 Atlantic Avenue Boston, MA 02210
NEMA	National Electrical Manufacturer's Association 155 East 44th Street New York, NY 10017
NESC	National Electric Safety Code American National Standards Institute 1430 Broadway New York, NY 10018
NETA	International Electrical Testing Association P. O. Box 687 Morrison, CO 80465
NFPA	National Forest Products Association (Formerly National Lumber Manufacturer's Association) 1619 Massachusetts Avenue, N.W. Washington, DC 20036
NFPA	National Fire Protection Association Batterymarch Park Quincy, MA 02269
OSHA	Occupational Safety and Health Act U.S. Department of Labor

Occupational and Health Administration

SAE	Society of Automotive Engineers 2 Pennsylvania Plaza New York, NY 10001
SAMA	Scientific Apparatus Makers Association One Thomas Circle Washington, DC 20005
SBCC	Southern Building Code Congress 1116 Brown-Marx Building Birmingham, AL 35203
SDI	Steel Door Institute 712 Lakewood Center N 14600 Detroit Avenue Cleveland, OH 44107
SMACNA	Sheet Metal and Air Conditioning Contractors National Association, Inc. 8224 Old Courthouse Road Tysons Corner Vienna, VA 22180
SSPWC	Standard Specifications for Public Works Construction Building News, Inc. 3055 Overland Avenue Los Angeles, CA 90034
TEMA	Tubular Exchanger Manufacturer's Association 331 Madison Avenue New York, NY 10017
UL	Underwriters Laboratories Inc. 207 East Ohio Street Chicago, IL 60611
UMC	Uniform Mechanical Code Published by ICBO
UPC	Uniform Plumbing Code Published by IAPMO
USBR	Bureau of Reclamation U.S. Department of Interior Engineering and Research Center

Denver Federal Center, Building 67
Denver, CO 80225

WWPA Western Wood Products Association
(Formerly called: West Coast Lumbermen's Association
(WCLA))
Yeon Building
Portland, OR 97204

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

(NOT USED)

END OF SECTION

SECTION 01190

STRUCTURAL DESIGN REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section is applicable for nonstructural components, nonbuilding structures, and structural elements of the project that are intended to be designed by others as a deferred submittal including, but not limited to:
1. Mechanical, Electrical, and Plumbing equipment and appurtenances including but not limited to:
 - a. Mechanical Equipment: items shown on the Mechanical drawings, mounted inside the building and/or outside on foundations, including anchorage.
 - b. Pumps and anchorage
 - c. Tanks and vessels (include contents), including anchorage and support systems.
 - d. Electrical Equipment: MCC Cabinets, transformers, switchgear, and other electrical components, including anchorage.
 - e. All equipment specifically identified within the Drawings, including anchorage.
 - f. Conduit, piping, cable trays, raceways, HVAC ducts and similar systems, if applicable.
 - g. Pipe supports and anchorage
 - h. Storage racks, suspended ceilings, light fixtures, raised floors, partitions, store-front, windows, louvers, architectural and other non-structural components.

1.02 REFERENCES

- A. 2018 HSBC Hawaii State Building Code (HSBC), based on the 2018 International Building Code. Effective Date: April 20, 2021. Errata and Addenda: August 17, 2021.
- B. 2018 IBC International Building Code, by the International Code Council, Inc., 2018.
- C. ACI 318 Building Code Requirements for Reinforced Concrete and Commentary, American Concrete Institute, 2014.
- D. ACI 355.2 Qualification of Post-Installed Mechanical Anchors in Concrete and Commentary, American Concrete Institute, 2019.
- E. ACI 355.4 Qualification of Post-Installed Adhesive Anchors in Concrete and Commentary, American Concrete Institute, 2011.

- F. AC01 Acceptance Criteria (AC) for Expansion Anchors in Masonry Elements, International Code Council Evaluation Service.
- G. AC58 Acceptance Criteria for Adhesive Anchors in Cracked and Uncracked Masonry Elements, International Code Council Evaluation Service, 2019.
- H. AC156 Acceptance Criteria for Seismic Certification by Shake-Table Testing of Nonstructural Components, International Code Council Evaluation Service.
- I. ASHRAE American Society of Heating, Refrigeration, and Air-Conditioning Engineers, Inc., Practical Guide to Seismic Restraint, 2nd Edition, 2012.
- J. ASCE 7-16 Minimum Design Loads and Associated Criteria for Buildings and Other Structures, American Society of Civil Engineers (ASCE/SEI 7-16)
- K. AWWA D100 Welded Carbon Steel Tanks for Water Storage, American Water Works Association, 2011.
- L. TMS 402/602 Building Code Requirements and Specifications for Masonry Structures, The Masonry Society (ACI 530 / ACI 530.1), 2016.
- M. SMACNA Sheet Metal and Air Conditioning Contractors National Association, Latest Edition.

1.03 DEFINITIONS

- A. Contract Documents: The Drawings and Specifications.
- B. Deferred Submittal: Portions of the design that have yet to be completed at the time of submittal of the Contract Documents. Deferred submittal items shall not be constructed or installed until the deferred submittal documents have been reviewed for general conformance by the Engineer of Record.
- C. Engineer of Record: The Engineer responsible for the preparation of Contract Documents.
- D. Specialty Engineer: Professional Civil Engineer or Structural Engineer licensed in the State where the project is being constructed, is responsible for nonstructural components, nonbuilding structures, and/or equipment supported by structures as identified in the Contract Documents as a deferred submittal. The Specialty Engineer shall be provided by the Contractor.

1.04 SUBMITTALS

- A. Complete calculations, details, and complete reference drawings that are required to be submitted as part of a deferred submittal and as defined in the IBC and the Structural Drawings, shall be prepared, stamped, signed, and furnished by a Professional Civil or Structural Engineer licensed to practice in the State where the project is being constructed.

B. Minimum Calculation and Reference Drawing Requirements:

1. Calculations shall be comprehensible and complete. When evaluating the structural strengths, indicate stress for comparing with strengths or show the demand versus capacity ratio in the structural elements. Evaluating the results by stating "Okay by Inspection" is not acceptable.
2. Derivation of forces used, including at least one complete sample calculation, showing the process used so that Engineer of Record may determine general conformance. Printouts of spreadsheets without explanation of calculations used to determine values are not acceptable.
3. The calculations and details shall demonstrate a complete vertical and lateral load path and shall clearly indicate all forces imposed on the supporting Kihei WWPS No. 9 Modifications 01190 - 3 Structural Design Requirements Job No. WW20-04structure. Include all load combinations used in the design shall be referenced and include a clear indication whether service level or strength level was used in the design.
4. Reference drawings shall include plans, sections, details and equipment information as necessary for calculations. Indicate the location of the equipment on plan which is necessary for the development of load calculations.
5. The Engineer of Record's review of the deferred submittal items identified in Contract Documents cannot be completed until all related items have been coordinated and submitted for review. Submittals will be returned without review if:
 - a. Submittals include only calculations without reference drawings.
 - b. Calculations have no sheet numbers or sheets are missing.
 - c. Calculations or reference drawings are illegible.
 - d. Calculations are made based on wrong information, assumptions or design parameters.
 - e. Information in reference drawings is insufficient for calculations or review.

C. Anchorage Calculations and Details:

1. Anchorage calculations and details shall be provided for all nonstructural components and nonbuilding structures required as part of the deferred submittal items. Anchorage calculations and details shall be sealed and signed by a Professional Civil or Structural Engineer licensed to practice in the State where the project is being constructed.
2. Submit anchorage calculations for nonstructural components and nonbuilding structures to resist dynamic operational, wind, and seismic forces in both concrete and masonry as required for the point of attachment relative to the Contract Documents.
3. Reduction factors associated with edge distance, embedment length, grout and base plate thickness, and bolt spacing shall be considered in the design and clearly indicated on the submittal drawings.
4. Anchorage details shall include the required concrete strength or masonry strength consistent with the Contract Documents, anchor bolt

- diameter, embed, spacing, and edge distances consistent with the calculations.
5. Include anchoring methods and leveling criteria for equipment consistent with manufacturer's recommendations.
 6. Final dimensions of equipment pads based on equipment size and edge distance required for anchorage. The Contractor shall coordinate the final dimensions of equipment pads, including any revisions required to meet the requirements of the favorably reviewed submittal by the Specialty Engineer at no additional cost to the Owner.
- D. Shop Drawings:
1. Contractor is responsible for coordinating the final foundation sizes with the final size of equipment and final anchorage calculations, including the coordination required for shop drawings relating to foundations or structures supported by nonbuilding structures and nonstructural components.
 2. Shop drawings that require anchor reinforcement or supplementary reinforcement by the Specialty Engineer shall be included in the shop drawing submittals.
 3. Shop drawings shall be submitted in accordance with the Contract Documents for items specified within their respective Specification Section.
- E. Seismic Certification of Equipment: Submit seismic certifications for equipment identified in the Contract Documents, that state the equipment itself is designed to resist all internal seismic forces based on the seismic design criteria for the project. Submit Level 1 or Level 2 certification as noted in the equipment specifications or Contract Documents. If no level is indicated, provide Level 1 certification.
1. Level 1 Certification shall consist of a written certification from the manufacturer that the equipment is capable of resisting the internal seismic loads due to the loading conditions noted herein and meeting the requirements of ASCE 7, Chapter 13.
 2. Level 2 Certification shall consist of a written certification from the manufacturer, and accompanying test results or experiential evidence, indicating compliance with ASCE 7, Chapter 13.
 3. For elements designed in accordance with ASCE 7, Chapter 15, Contractor shall submit complete calculations in accordance with this Section for the nonbuilding structure in lieu of seismic certification unless specifically identified in the Contract Documents.
- F. Quality Assurance Submittals
1. Evaluation Reports: Submit the current and relative ICC-ESR or IAPMO-UES reports used in the design of anchorage and other structural elements.
 2. Seismic Certification: Submit seismic certification for equipment as identified in the Contract Documents.

3. Verification of Installation: Submit a letter from the Contractor's Specialty Engineer verifying that the installation was performed as required by the Specialty Engineer's calculations. The Contractor shall be qualified to install post-installed anchors.
4. Test Reports: Submit test reports for testing of anchors in accordance with the Contract Documents.

1.05 QUALITY ASSURANCE

- A. Qualifications: The Contractor is responsible for submitting sealed and signed structural calculations and detailed drawings from a Specialty Engineer, licensed as Professional Civil or Structural Engineer in the State where the project is being constructed
- B. Regulatory Requirements: Comply with the HSBC, IBC, ASCE 7, applicable reference documents, and Contract Documents.
- C. Special Inspection: Special Inspections and testing shall be performed as referenced in the Contract Documents.

1.06 GENERAL DESIGN REQUIREMENTS

- A. Design Basis and Coordination: Contractor shall note that the layout of the structures and equipment pads shown on the Drawings have been developed based on the limits in the Contract Documents.
 1. Contractor shall coordinate all attachments and related work and shall provide connections as noted in the favorably reviewed shop drawings.
 2. For all suppliers, if the dimensions required by the Contractor's submitted anchorage calculations deviate from those provided in the Contract Documents, Contractor shall note the deviation in the submittal for review and provide the favorably reviewed pad at no additional cost to the Owner.
 3. Contractor shall coordinate all related work and deviations from the Contract Documents.
- B. The Contractor is responsible for producing designs that resist dynamic operational, wind, seismic forces in accordance with the Contract Documents. The Contractor is responsible for coordinating between the Engineer of Record and the Specialty Engineer.
- C. Coordinate the layout so that adequate space is provided between items for relative motion. Provide additional supports and restraints between items of different systems when necessary to prevent lateral impacts or interaction.
- D. Structural Design Criteria: For the design of deferred submittal items, nonstructural components and nonbuilding structures, the Specialty Engineer shall follow the structural design parameters listed on the Structural Drawing Sheet S-1: floor live loads, roof live loads, snow and rain load data, wind design data, seismic design data, earth forces, geotechnical information, and flood design data (if applicable).

- E. The total operating weight of the equipment for nonstructural components and nonbuilding structure shall be considered in the development of the seismic design forces.
- F. Nonstructural components, nonbuilding structures, and structural elements shall be designed for a concurrent vertical acceleration force. Where required by ASCE 7, the effects of vertical ground motions for nonbuilding structures shall be used in lieu of the vertical acceleration force.
- G. Orthogonal Effects: Nonstructural components and nonbuilding structures shall be designed for orthogonal effects as required in the HSBC, IBC and ASCE 7.
- H. Nonstructural Components:
 - 1. The seismic design for nonstructural components and anchorage shall be in accordance with Chapter 13 of ASCE 7, and the required coefficients and factors for determining the total design seismic forces shall be shown on the deferred submittal drawings.
 - a. Component Importance Factor, I_p : per Structural Drawings.
 - b. Component Amplification Factor, a_p : per ASCE 7, Chapter 13
 - c. Component Response Modification Factor, R_p : per ASCE 7, Chapter 13
 - d. Overstrength Factor, Ω_o : per ASCE 7, Chapter 13
 - 2. Nonstructural components contained inside modular systems shall be designed in accordance with ASCE 7, Chapter 13.
- I. Nonbuilding Structures:
 - 1. The seismic design for nonbuilding structures and anchorage shall be in accordance with Chapter 15 of ASCE 7. The required coefficients and factors for determining the total seismic forces shall be shown on the deferred submittal drawings.
 - a. Seismic Importance Factor, I_E : per Structural Drawings.
 - b. Response Modification Factor, R : per ASCE 7, Chapter 15
 - c. Overstrength Factor, Ω_o : per ASCE 7, Chapter 15
 - d. Deflection Amplification Factor, C_d : per ASCE 7, Chapter 15
 - 2. Premanufactured mechanical and electrical modules 6 feet high and taller that are not otherwise prequalified with ASCE 7, Chapter 13 and contain or support mechanical equipment and electrical components shall be designed in accordance with the provisions of ASCE 7, Chapter 15.
- J. Nonstructural components and nonbuilding structures, that are located outside, shall be designed for the condition in which the component or structure is empty, subjecting the component or structure to wind forces while not in operation. This includes the anchorage of nonstructural and nonbuilding structures.

1.07 ANCHORAGE

- A. Anchorage of nonstructural components and nonbuilding structures shall be designed to resist static, dynamic operational, seismic, and wind forces.
- B. Anchorage calculations in both concrete and masonry shall clearly show that the capacity of the anchor and the capacity of the concrete/masonry that the anchor is attached to are adequate to resist all applicable load combinations in the HSBC, IBC, and ASCE 7.
 - 1. The design of anchors resisting seismic forces shall satisfy the ductility requirements stated in the HSBC, IBC, ASCE 7, and ACI 318 or TMS 402/602.
 - 2. Post-installed anchors installed in concrete shall be prequalified for seismic applications in accordance with ACI 355.2 and ACI 355.4.
 - 3. Post-installed anchors installed in masonry shall be prequalified for seismic applications in accordance with AC01 and AC58.
- C. Anchorage shall be designed for dynamic operational forces and operating torque, if applicable, for vertical turbine pumps / vibratory equipment.
- D. Anchorage shall be designed for bending in the anchor due to eccentricity where raised grout pads will be installed for leveling.
- E. Anchor reinforcement or supplementary reinforcement deemed necessary to satisfy the anchorage design by the Specialty Engineer, shall be included at no additional cost to the Owner. Contractor is responsible for coordinating any anchor reinforcement or supplementary reinforcement with the shop drawings prior to fabrication. Anchor reinforcement or supplementary reinforcement shall be detailed in accordance with ACI 318.

1.08 DESIGN REQUIREMENTS FOR STRUCTURES EXPOSED TO LIQUIDS

- A. Basis of Design for Structures Exposed to Liquids: Design structures that are located inside liquid-containing structures that are exposed to liquids on one or both sides. These structures are subjected to out-of-plane forces during a seismic event where the structure is subjected to differential hydrodynamic fluid forces.
- B. Interior elements, such as baffles, columns, or roof supports, shall be designed for the effects of unbalanced forces and sloshing.
- C. Rigid items such as piping, separation walls, columns, weirs, or equipment/pipe supports shall be designed for hydrodynamic, differential hydrodynamic fluid, and their own inertia forces.

1.09 ELECTRICAL EQUIPMENT FOUNDATIONS AND PADS

- A. Electrical equipment foundations and housekeeping pads shall be coordinated with the Contract Documents and the anchorage requirements determined from the Specialty Engineer. The final dimensions of electrical equipment foundations and housekeeping pads shall not violate the

- applicable code provisions for the specified equipment, including but not limited to the provisions of the National Electric Code.
- B. Electrical equipment housekeeping pads shall be 3.5 inches tall at the front of the equipment, unless otherwise specified within the Contract Documents. Contractor shall coordinate the final elevations with electrical.
 - C. Contractor shall verify the size and operating weight of the equipment with the Contract Documents and equipment manufacturer. Notify the Engineer of Record of any discrepancies between the equipment submittal and the Contract Documents prior to construction of the foundations.

1.10 MECHANICAL EQUIPMENT FOUNDATIONS

- A. Mechanical equipment foundations and pads shall be coordinated with process equipment and piping elevations.
- B. Contractor shall verify the size and operating weight of the equipment with the Contract Documents and equipment manufacturer. Notify the Engineer of Record of any discrepancies between the equipment submittal and the Contract Documents prior to construction of the foundations.

1.11 DESIGN REQUIREMENTS FOR PIPING, CONDUITS, AND DUCTWORK

- A. The Contractor is responsible for producing designs for support of piping, conduit, duct or other systems to resist total seismic forces based on the seismic design criteria coefficients specified above, unless shown on the Contract Documents. Except where the technical specifications give specific exemption from resistance of seismic forces, all supports shall be designed to meet seismic criteria. Support systems for piping, conduit, duct or other systems greater than 5 inches in diameter are shown on the Contract Documents.
- B. Where possible, pipes, conduit, and their connections shall be constructed of ductile materials (e.g., copper, stainless, steel, brass, ductile iron, steel or aluminum and brazed, welded or screwed connections). Pipes, conduits and their connections, constructed of non-ductile materials (e.g., cast iron, no-hub pipe and plastic), shall have the brace spacing reduced to one-half of the spacing allowed for ductile material.
- C. Seismic restraints may be omitted for the following conditions, where flexible connections are provided between components and the associated ductwork, piping and conduit:
 1. All non-fuel piping less than 2.5 inches inside diameter or all piping suspended by individual hangers 12 inches or less in length from the top of the pipe to the bottom of the structural support for the hanger or electrical conduit less than 2.5 inches trade size.
- D. All trapeze assemblies supporting pipes, ducts and conduit shall be braced to resist the total seismic forces considering the weight of the elements on the trapeze. Pipes, ducts and conduit supported by a trapeze where none of

those elements would individually be braced need not be braced if connections to the pipe/conduit/ductwork or directional changes do not restrict the movement of the trapeze. If this flexibility is not provided, bracing will be required when the aggregate weight of the pipes and conduit exceed 10 pounds/foot. The weight shall be determined assuming all pipes and conduit are filled with water.

- E. As an alternative to designing the supports and anchorage, where an approved national standard provides a basis for the earthquake-resistant design, submit standard, data, and details for piping, conduit, duct or other systems consistent with the code requirements referenced in the Contract Documents.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

3.01 FIELD QUALITY CONTROL

- A. Special Inspections and tests of elements, nonstructural, and nonbuilding structures shall meet the requirements of the Contract Documents and applicable Codes. The owner shall retain a qualified Special Inspector (other than the Contractor), who shall provide all special inspections and testing necessary to meet the Contract Documents and Code requirements during Construction. Special inspections are in addition to inspections performed by the Authority Having Jurisdiction.
- B. Post-Installed Anchors: For post-installed anchors in concrete and masonry, proof load tests shall be in accordance with the relative and current ICC-ESR / IAPMO- UES report, unless indicated otherwise in the Contract Documents.
- C. All testing of anchors shall be performed in the presence of the Special Inspector. Reports of the testing of anchors shall be submitted directly to the Engineer of Record.
- D. Base Bid Estimate: Unless otherwise noted within the Contract Documents, the following shall serve as the basis for the bid estimate for testing of post-installed anchors and high-strength bolts.
 1. Post-Installed Anchors: Minimum of 20 proof load tension testing or ten percent of the post-installed installed anchors.
 2. High Strength Bolts: Minimum 40, or as specified within the Special Inspection tables.

END OF SECTION

SECTION 01200

PROJECT MEETINGS

PART 1 - GENERAL

1.01 GENERAL

During the construction period, meetings will be conducted at weekly intervals or at some other regular frequency approved by the Construction Manager. These meetings shall be attended by the Construction Manager, the Contractor's Project Manager with appropriate staff, subcontractors, or suppliers. Meetings shall include a preconstruction meeting, construction progress meetings and other meetings called by the Construction Manager in response to developments during the Work.

1.02 PRECONSTRUCTION MEETING

Prior to start of construction, a pre-construction meeting will be called for the purpose of reviewing the construction program with the Contractor. At this meeting, detailed program, sequence of Work, methods of access to construction sites and temporary facilities shall be agreed upon between the Construction Manager and Contractor. All interested agencies and utility companies will be invited to discuss their interests and requirements relating to the Project. Contractor and all subcontractor representatives shall attend.

1.03 CONSTRUCTION PROGRESS MEETINGS

A. GENERAL:

The Construction Manager or his designated representative shall conduct the weekly construction period meetings.

B. AGENDA:

Project meetings will include reports on construction progress, Work schedule and sequencing requirements, coordination of building trades, coordination with other Contracts and public utilities, the status of submittal reviews, the status of information requests, and any general business.

C. DOCUMENTATION:

Construction Manager shall keep minutes of the proceedings. The minutes shall be typed and distributed to all attendees within 48 hours of each meeting.

1.04 QUALITY ASSURANCE

A. SUBMITTALS:

In accordance with specification Section 01300, "SUBMITTALS," and in addition to the requirements of that section, the following submittals shall be provided:

1. Project Schedule.

1.05 OTHER

Other meetings may be called by the Construction Manager as warranted by unforeseen developments during construction.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

(NOT USED)

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Submittals covered by these requirements include manufacturers' information, shop fabrication drawings, test procedures, test results, samples, requests for substitutions, and miscellaneous Work-related submittals. Submittals shall also include, but not be limited to, all mechanical, electrical and electronic equipment and systems, materials, reinforcing steel, fabricated items, and piping and conduit details. The Contractor shall furnish all drawings, specifications, descriptive data, certificates, samples, tests, methods, schedules, and manufacturer's installation and other instructions as specifically required in the Contract Documents to demonstrate fully that the materials and equipment to be furnished and the methods of Work comply with the provisions and intent of the Contract Documents.
- B. All submittals required by the Contract Documents shall be transmitted from the Contractor to the Construction Manager. Submittals shall not be transmitted from subcontractors nor manufacturers. All submittals shall be stamped, signed, and dated by the Contractor to signify his approval and that he has checked them for content, accuracy and dimensions. Items found to be inaccurate or otherwise in error shall be returned by the Contractor to the subcontractor or supplier for correction before submitting to the Construction Manager.
- C. All details on shop drawings submitted for review shall clearly show the elevations of the various parts of the main members and lines of the structure, and where correct fabrication of the Work depends upon field measurements, such measurements shall be made and noted on the drawings before the drawings are submitted for review.

1.02 CONTRACTOR'S RESPONSIBILITIES

- A. The Contractor shall be responsible for the accuracy and completeness of the information contained in each submittal and shall assure that the material, equipment or method of Work shall be as described in the submittal. The Contractor shall verify that all features of all products conform to the specified requirements. Submittal documents shall be clearly edited to indicate only those items, models, or series of equipment, which are being submitted for review. All extraneous materials shall be crossed out or otherwise obliterated. The Contractor shall ensure that

there is no conflict with other submittals and notify the Construction Manager in each case where his submittal may affect the work of another Contractor or the County. The Contractor shall coordinate submittals among his subcontractors and suppliers including those submittals complying with unit responsibility requirements and multiple applicable technical sections.

- B. The Contractor shall coordinate submittals with the Work so that Work will not be delayed. He shall coordinate and schedule different categories of submittals, so that one will not be delayed for lack of coordination with another. No extension of time will be allowed because of failure to properly schedule submittals. The Contractor shall not proceed with Work related to a submittal until the submittal process is complete. This requires that submittals for review and comment shall be returned to the Contractor stamped "No Exceptions Taken" or "Make Corrections Noted."
- C. The Contractor shall certify on each submittal document that he has reviewed the submittal, verified field conditions, and complied with the Contract Documents.
- D. The Contractor may authorize in writing a material or equipment supplier to deal directly with the Construction Manager in regard to a submittal. These dealings shall be limited to Contract interpretations to clarify and expedite the Work and shall not relieve the Contractor of his responsibilities nor obligations as specified in these Contract Documents.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

3.01 CATEGORIES OF SUBMITTALS

A. GENERAL:

1. Submittals fall into two general categories; those for review and comment, and those which are primarily for information only. Submittals which are for information only are generally specified as PRODUCT DATA in Part 2 of applicable specification sections. A table summarizing most of the (1) submittals for review and comment, (2) product data submittals for information only, (3) operation and maintenance manuals/information, and (4) training submittals, is provided under paragraph 01300-3.02. If there are any conflicts

between the summary table and requirements in the individual sections, the Contractor may request clarification from the Construction Manager. The Contractor shall be prepared to comply with the more stringent of the requirements.

2. Throughout the course of the Work, the Contractor shall update a submittal list with a suitable spreadsheet, and report status and dates of submittals for review and comment. The updated list will be submitted monthly with progress payment information.

B. **SUBMITTALS FOR REVIEW AND COMMENT:**

1. All submittals except where specified to be submitted as product data for information only shall be submitted by the Contractor to the Construction Manager for review and comment. Submittal requirements for operation and maintenance manuals are specified in Section 01730, "OPERATING AND MAINTENANCE INFORMATION." Submittal requirements for training the County's personnel are specified in Section 01664, "TRAINING."

C. **PRODUCT DATA SUBMITTALS FOR INFORMATION ONLY:**

1. Where specified, the Contractor shall furnish product data to the Construction Manager for information only.

3.02 TRANSMITTAL PROCEDURE

- A. Unless otherwise specified, submittals regarding material and equipment shall be accompanied by Transmittal Form 01300-A specified in Section 01999, "REFERENCE FORMS," completed by the Contractor. Submittals for operation and maintenance manuals, information and data shall be accompanied by Transmittal Form 01730-A specified in Section 01999, "REFERENCE FORMS." A separate form shall be used for each specific item, class of material, equipment, and items specified in separate, discrete sections, for which the submittal is required. Submittal documents common to more than one piece of equipment shall be identified with all the appropriate equipment numbers. Submittals for various items shall be made with a single form when the items taken together constitute a manufacturer's package or are so functionally related that expediency favors checking or review of the group or package as a whole is warranted.
- B. Shop drawings for components of a system or systems requiring unit responsibility shall be submitted together with all other system components as a complete shop drawing package. Failure to submit data for the complete system will be cause for rejection of individual submittals.

C. A unique number, sequentially assigned, shall be noted on the transmittal form accompanying each item submitted. Original submittal numbers shall have the following format: "XXX"; where "XXX" is the sequential number assigned by the Contractor. Resubmittals shall have the following format: "XXX-Y"; where "XXX" is the originally assigned submittal number and "Y" is a sequential letter assigned for resubmittals, i.e., A, B, or C being the 1st, 2nd, and 3rd resubmittals, respectively. Submittal 25B, for example, is the second resubmittal of Submittal 25. Required submittals for review, product data information, O&M manuals, and training are listed in the following schedule. Submittals shall be performed in accordance with the table information below and the requirements of this section in those cases where submittals are not indicated in individual specification sections.

3.03 DEVIATION FROM CONTRACT

- A. If the Contractor proposes to provide material, equipment, or method of work which deviates from the Contract Documents, he shall indicate so under "deviations" on the transmittal form accompanying the submittal copies.

3.04 SUBMITTAL COMPLETENESS

- A. Submittals shall be complete for each Specification Section. Submittals which do not have all the information required to be submitted, including deviations, are not acceptable and will be returned without review. Submittals which do not contain the Contractor's signature and date submitted along with Transmittal Form 01300-A will be unacceptable and returned without review.

3.05 DISTRIBUTION

- A. Distribute reproductions of reviewed shop drawings and copies of reviewed product data and samples to the job site maintenance manuals. Special tools, accessories and spare parts shall be submitted to the Construction Manager or delivered to the County, as appropriate.

3.06 REPETITIVE REVIEW

- A. Shop drawings, equipment submittals, and O&M manuals submitted for each item will be reviewed no more than twice at the County's expense. All subsequent reviews will be performed at times convenient to the Construction Manager and at the Contractor's expense, based on the Construction Manager's then prevailing rates. The Contractor shall reimburse the County for all such fees invoiced to the County by the Construction Manager.
- B. Any need for more than one resubmission, or any other delay in obtaining Construction Manager's review of submittals, will not entitle Contractor to an extension of the Contract Time.

3.07 REVIEW PROCEDURE

A. GENERAL:

1. Submittals are specified for those features and characteristics of materials, equipment, and methods of operation which can be selected based on the Contractor's judgment of their conformance to the specified requirements. Other features and characteristics are specified in a manner which enables the Contractor to determine acceptable options without submittals. The review procedure is based on the Contractor's guarantee that all features and characteristics not requiring submittals conform as specified. Review shall not extend to means, methods, techniques, sequences or procedures of construction, or to verifying quantities, dimensions, weights or gages, or fabrication processes (except where specifically indicated or required by the Contract Documents) or to safety precautions or programs incident thereto. Review of a separate item, as such, will not indicate approval of the assembly in which the item functions. The review of submittals by the Construction Manager does not relieve the Contractor from his responsibility with regard to the fulfillment of the terms of the Contract. All risks of error and omission are assumed by the Contractor and the Construction Manager will have no responsibility therefore.
2. Project Work, materials, fabrication, and installation shall conform with reviewed shop drawings, working drawings, applicable samples, and catalog data.
3. When the Contract Documents require a submittal, the Contractor shall submit the specified information as follows:
 - a. Seven (7) copies of all submitted information plus one reproducible original of all information shall be transmitted to the Construction Manager with submittals for review and comment.

- b. Unless otherwise specified, three (3) copies of all submitted information shall be transmitted with (product data) submittals for information only.

B. SUBMITTALS FOR REVIEW AND COMMENT:

1. Unless otherwise specified, within 28 calendar days after receipt of a submittal for review and comment, the Construction Manager shall review the submittal and return two copies with comments. The period for return of submittals is exclusive of any time awaiting clarification or further information for submittals which are incomplete in themselves or should be packaged together with other functionally related equipment. The Construction Manager reserves the right to retain submittal packages beyond 28 days if the package is unusually complex, voluminous or includes components with extensive interfaces with other project Work. The reproducible original will be retained by the Construction Manager. The returned submittal shall indicate one of the following actions:
 - a. If in the review, compliance with the Contract Documents was observed for material, equipment or Work method, submittal copies will be marked "NO EXCEPTIONS TAKEN." In this event, the Contractor may begin to implement the Work method or incorporate the material or equipment covered by the submittal.
 - b. If the review indicates limited corrections are required, copies will be marked MAKE CORRECTIONS NOTED." The Contractor may begin implementing the Work method or incorporating the material and equipment covered by the submittal in accordance with the noted corrections. Where submittal information will be incorporated in O&M data, a corrected copy shall be provided.
 - c. If the review reveals that the submittal is insufficient or contains incorrect data, copies will be marked "AMEND AND RESUBMIT." The Contractor shall not undertake Work covered by this submittal until it has been revised, resubmitted and returned marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED," except at his own risk.
 - d. If the review indicates that the material, equipment, or Work method does not comply with the Contract Documents, copies of the submittal will be marked "REJECTED - SEE REMARKS." Submittals with deviations which have not been identified clearly may be rejected. The Contractor shall not undertake the Work covered by such submittals until a new submittal is made and returned marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED," except at his own risk.

C. PRODUCT DATA SUBMITTALS FOR INFORMATION ONLY:

1. Such information is not subject to submittal review procedures and shall be provided as part of the Work under this Contract and its acceptability determined under construction observations and inspection procedures in the field. No response will be provided back to the Contractor.

3.08 EFFECT OF REVIEW OF CONTRACTOR'S SUBMITTALS

- A. Review of Contract Drawings, methods of Work, or information regarding materials or equipment the Contractor proposes to provide, shall not relieve the Contractor of his responsibility for errors therein and shall not be regarded as an assumption of risks or liability by the Construction Manager or the County, or by any officer or employee thereof, and the Contractor shall have no claim under the Contract on account of the failure, or partial failure, of the method of Work, material, or equipment so reviewed. A mark of "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED" shall mean that the County has no objection to the Contractor, upon his own responsibility, using the plan or method of Work proposed, or providing the materials or equipment proposed.

END OF SECTION

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SECTION 01310

CONSTRUCTION SCHEDULE

PART 1 - GENERAL

1.01 GENERAL

This section specifies the procedures for preparing and revising the cost-loaded construction schedule used for planning and managing construction activities. The schedule provides a basis for determining the progress status of the project relative to the completion time, specific dates, any other specific intermediate milestone dates for determining the acceptability of the Contractor's progress payment estimates. Schedule shall accurately and clearly reflect the sequencing and constraints required by Section 01014, "WORK SEQUENCE."

1.02 DESCRIPTION

The Contractor shall prepare a time-scaled network schedule using bar charts.

In general, Contractor shall assure the Construction Schedule is:

- A. Unambiguous: Clear as to what is to be done, where it is to be done, who is to do it, and when it is to be done.
- B. Finite: Readily identifiable beginning and end points for each activity.
- C. Interdependent: Logical relationship between activities clearly indicated.
- D. Results-oriented: Purpose of an activity is to be the achievement of a specific result or results, such as floor slab, a test, or a decision.
- E. Unique: Work included in an activity is not to be included in any other activity.
- F. Collectively complete: All of the project work is to be included in the bar chart items.
- G. Appropriately detailed: Each activity shown is to have a duration of less than 15 days and each activity is to have an assigned cost of no more than \$25,000. The dollar value of each activity should be identified.

The schedule shall depict all significant construction activities, material and equipment deliveries, Contractor submittals and submittal approvals, testing and commissioning, training activities, and all items of work listed in the breakdown of contract prices submitted by the Contractor. Assigned durations for each activity

shall be indicated. Assigned values for each part of the work shall be indicated. The dependencies between activities shall be indicated so that it may be established what effect the progress of any one activity has on the schedule. Activities making up the critical path shall be identified, and the amount of float on non-critical activities shall also be indicated. All completion dates shown on the schedule shall be within the time period indicated in the contract. Failure to include any element of work required for the performance of this contract shall not excuse the Contractor from completing all work required within any applicable completion date, notwithstanding the Construction Manager's approval of the schedule.

Completion time given in Section 01010, "SUMMARY OF WORK," specific dates, and sequencing requirements described in Section 01014, "WORK SEQUENCE," shall be shown on the schedule. Other contracts shall be taken into account in the schedule. Activities making up the critical path shall be identified.

Unless specifically approved by the Construction Manager, no activity on the schedule shall have a duration longer than fifteen (15) days or assigned value greater than \$25,000. Activities which exceed these limits shall be divided into more detailed components. The scheduled duration of each activity shall be based on the work being performed during the normal 40-hour work week, including all work done after normal working hours in conjunction with sewage bypass operations, with allowances made for legal holidays and normal weather conditions.

Contractor shall include Submittal, Fabrication and Delivery activities for all single equipment valued greater than \$25,000, delivery times greater than six (6) months, or on the critical path.

1.03 QUALITY ASSURANCE

A. SUBMITTALS:

In accordance with specification Section 01300, "SUBMITTALS," and in addition to the requirements of that section, the following submittals shall be provided:

1. Construction Schedule

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

3.01. SUBMITTAL PROCEDURES

Within **twenty (20) calendar days** after the date of the Notice to Proceed, the Contractor shall complete a construction schedule conforming to the above and representing in detail all planned procurement and on-site construction activities. Contractor shall prepare and submit the schedule to the Construction Manager.

Contractor shall submit the original and two copies to the Construction Manager.

Within **fifteen (15) calendar days** after receipt of the submittal, the Construction Manager shall review the submitted schedule and return one copy of the marked up original to the Contractor. If the Construction Manager finds that the submitted schedule does not comply with specified requirements, the deficiencies will be noted on the submittal copy returned to the Contractor for corrections and resubmitted as specified in Section 01300, "SUBMITTALS." The Contractor shall correct and resubmit the schedule within ten (10) days after the deficiencies have been identified by the Construction Manager.

The schedule will serve as the basis for the Contractor's progress payment requests. Contractor shall be responsible for the adequacy of the schedule and for managing all construction activities including those of subcontractors and suppliers.

3.02. PROJECT STATUS UPDATE

Throughout the Construction Phase of the contract, the Contractor shall provide a three-week look-ahead bar chart which shall include:

- A. Main schedule activity ID numbers.
- B. Main schedule activity descriptions.
- C. Three-week schedule subactivities.
- D. Signature of Contractor's General Superintendent.
- E. Bar chart including start and finish dates and corresponding bars.
- F. Activities no longer than three (3) days in length.
- G. Activities impacting the County's operations and as defined in Section 01040, "COORDINATION WITH OPERATION OF EXISTING FACILITIES," shown highlighted and two (2) weeks ahead of early start

date to permit the Construction Manager to coordinate these critical activities between the County and Contractor.

Contractor shall provide a 3-week schedule to the Construction Manager on a weekly basis before starting any of the activities.

3.03. SCHEDULE REVISIONS

Proposed revisions to the accepted cost-loaded construction schedule must be submitted in writing to the Construction Manager and the County. Changes in timing, specific dates identified in the contract, resources, or durations for activities may be modified with written agreement between the Contractor and Construction Manager. A change affecting the contract value of any activity, the timing of any activity on the critical path, the completion time in Section 01010, "SUMMARY OF WORK," specific dates, and work sequencing in Section 01014, "WORK SEQUENCE AND CONTINUITY OF OPERATIONS," may be made only in accordance with applicable provisions of Section 00710.

If the actual sequence of work performed by the Contractor deviates from the planned sequence indicated in the accepted schedule, the Construction Manager may require the Contractor to revise the schedule to reflect changes in the actual sequence and/or the future sequence of work. Such revisions shall be submitted in accordance with Paragraph 3.01 above.

3.04. CONSTRUCTION PROGRESS

The Contractor shall furnish such manpower, materials, facilities, and equipment as may be necessary to insure the prosecution and completion of the work in accordance with the accepted schedule. If work falls 14 days or more behind the accepted construction schedule, the Contractor agrees that he will take some or all of the following actions to return the project to the accepted schedule. These actions may include the following:

- A. Increase manpower in quantities and crafts.
- B. Increase the number of working hours per shift, shifts per working day, working days per week, or the amount of equipment, or any combination of the foregoing.
- C. Reschedule the activities.

If requested by the Construction Manager, the Contractor shall prepare a proposed revised schedule demonstrating a plan to make up the lag in progress and insure completion of the work within the contract time. The proposed revision shall be submitted to the Construction Manager in accordance with paragraph 3.01 above. Upon receipt of an acceptable proposed schedule, the

revision to the construction schedule shall be made in accordance with the requirements described herein. All actions to return the project to the accepted schedule are at the Contractor's expense.

Contractor further understands and agrees that none of the services performed by the Construction Manager in monitoring, reviewing and reporting project status, and progress shall relieve the Contractor from responsibility for planning and managing construction work in conformance with the construction schedule.

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SECTION 01500

CONTRACTOR'S UTILITIES AND TEMPORARY FACILITIES

PART 1 - GENERAL

1.01 DESCRIPTION

This section describes the site utility and temporary facility requirements for the project.

- A. Office: The Contractor is not required to provide an office at the site.
- B. Power: The Contractor shall provide power for all work at the project site.
- C. Telephone: The Contractor and his representative at the work site shall be accessible by phone at all times.
- D. Sanitary Facilities: Sanitary facilities are not available at the project site. It shall be the responsibility of the Contractor to furnish temporary sanitary facilities for his work crew.
- E. Water: If potable water is required, the Contractor shall provide water trucks at his own expense or make arrangements with the County Department of Water Supply for potable water takeoff points and temporary metering and shall pay the costs and fees arising therein.
- F. Access Roads and Parking: Areas for Contractor parking and construction staging shall be identified by the Contractor and coordinated with the Construction Manager. The site shall be maintained to prevent tracking mud onto roadways. The Contractor shall provide procedures or means required to prevent abnormal dust conditions during dry weather to the satisfaction of the Construction Manager.
- G. Rubbish Disposal: During the course of the Contract, rubbish shall be collected in containers of suitable size or number to prevent piling of rubbish outside of the containers. Collection and disposal shall be performed at regular intervals or as needed to keep rubbish build-up under control. All debris disposal areas shall prevent wind from spreading the debris.
- H. Solvents, greases, oils, and other such wastes shall be packaged and disposed of by other qualified carriers in a manner required by the laws governing the handling of such materials.

- I. Security: The Contractor shall be solely responsible to secure all of his tools, equipment and materials that are left at the site. The County will not be responsible for loss of property suffered by the contractor due to theft or vandalism, including in cases where said Contractor's property has been temporarily stored inside a county facility building with or without the County's consent.
- J. Removal of Temporary Facilities and Utilities: At such time as any temporary construction facilities or utilities are no longer needed for the Work, the Contractor shall notify the Construction Manager of his intent and schedule removal. The Contractor shall disconnect, dismantle, and remove such items from the site as his property, including access roads and parking areas. The Contractor shall leave the site in a condition as specified in Sections 01700 and 01710.
- K. In unfinished areas, the condition of the site shall be left in a way that will restore original drainage, be evenly graded, incorporate erosion control and left with an appearance equal to or better than the original condition. Preconstruction photographs may be used to assist in determining that these requirements have been satisfied.

PART 2 – PRODUCTS

(NOT USED)

PART 3 – EXECUTION

(NOT USED)

END OF SECTION

SECTION 01560

ENVIRONMENTAL CONTROLS

PART 1 - GENERAL

1.01 DESCRIPTION

This section describes the project's environmental control requirements.

A. SITE MAINTENANCE:

The Contractor shall keep the work site clean and free from rubbish and debris as specified in Section 01500. Materials and equipment shall be removed from the site when they are no longer necessary. Upon completion of the work and before final acceptance, the work site shall be cleared of equipment, unused materials, and rubbish to present a clean and neat appearance.

B. WORK HOURS:

1. General: Regular work hours shall be **7:00 am to 3:30 pm, Monday to Friday except State/County holidays**. For work to be done outside regular hours, Contractor shall submit written requests no later than the previous working day. Contractor shall pay for any required overtime inspection for work occurring outside of regular hours.
2. Equipment and Materials Deliveries: The Contractor shall notify all subcontractors, suppliers, and others that deliveries shall only be permitted during regular work hours. Special arrangements shall be made by the Contractor with the Construction Manager for deliveries on Saturdays.

C. AIR POLLUTION CONTROL:

The Contractor shall not discharge smoke, dust, and other contaminants into the atmosphere that violate the regulations of any legally constituted authority. Burning of any kind will not be permitted. The Contractor is responsible for obtaining all applicable permits and approvals for dust abatement. He shall also abate dust nuisance by cleaning, sweeping, and sprinkling with water. The use of water, in amounts which result in mud on public or plant streets, is not acceptable as a substitute for sweeping or other methods.

D. NOISE CONTROL:

Noise from Contractor's operations shall not exceed limits established by the State of Hawaii, Department of Health, Title 11, Administrative Rules, Chapter 46; Community Noise Control.

E. WATER POLLUTION AND SOIL CONTAMINATION:

The Contractor shall comply with all Federal, State and local laws and regulations which apply to water pollution and soil contamination. At no time shall the Contractor release or dump solvents, paints, gasoline or other fuels or oils into any portion of the sewers or process facilities.

In order to minimize the possibility of water or soil contamination due to spills of crankcase oil, gasoline and other fuels, the Contractor shall designate an area for the storage and handling of lubricants, fuels and other supplies which is acceptable to the Construction Manager. The Contractor shall comply with all applicable Federal, State and local rules and regulations related to the reporting and cleanup of spills.

F. ARCHEOLOGICAL MONITORING:

The Contractor shall provide an archeologist to be onsite at all times for ground disturbing activities. In the event that any unidentified archaeological sites or remains are encountered, the Contractor shall immediately suspend work and notify the State Department of Land and Natural Resources, Historic Preservation Division.

G. PROTECTION OF PROPERTY:

1. The Contractor shall be responsible for the preservation of all public and private property and shall use every precaution to prevent damage thereto. If any direct or indirect damage is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the work on the part of the Contractor, such property shall be restored by the Contractor, at his expense, to a condition similar or equal to that existing before the damage was done, or he shall make good the damage in other manner acceptable to the County.
2. Contractor shall be responsible for all damage to structures, utilities, streets, roads, highways, shoulders, ditches, embankments, culverts, bridges, or other public or private property, regardless of location or character, which may be caused by transporting equipment, materials, or personnel to or from the work or any part or site thereof, whether by him or his subcontractors. Contractor shall make satisfactory and acceptable arrangements

with the owner of, or the agency or authority having jurisdiction over, the damaged property concerning its repair or replacement or payment of costs in connection with the damage.

END OF SECTION

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SECTION 01565

PRE-CONSTRUCTION SURVEY

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes requirements for conducting a pre-construction survey to document pre-existing conditions for use in evaluating the adequacy of restoration work and contesting any damage claims by third parties.

1.02 SUBMITTALS

An electronic copy (PDF) of a pre-construction survey report, which shall include key maps, captioned hard copy photographs, and any field notes and sketches, shall be submitted to the Construction Manager for review and information in accordance with Section 01300, "SUBMITTALS."

The pre-construction survey report shall be provided to the Construction Manager at least thirty (30) calendar days prior to beginning any demolition, construction, or flow bypassing work at the site.

1.03 SURVEY REQUIREMENTS

- A. Prior to the start of any demolition, construction, or excavation work, the Contractor shall perform a pre-construction survey of all existing buildings, structures, pavements, sidewalks, walls, fencing, landscaping and other improvements that are within 20 feet of affected project areas, unless otherwise directed by the Construction Manager. As a minimum, the survey shall involve taking photographs, recording field observations and measurements in a field notebook and making sketches to document the pre-construction conditions of existing improvements. Photographs and other documentation shall show the general appearance and condition of improvements and provide close-up shots and detailed information on any areas where existing cracks, distress or damage are present.
- B. The photographs shall be in digital format. Each photograph shall be provided with captions to indicate the date, location and description of the photograph. A key map showing the location and direction of photograph shall be prepared.
- C. At the Contractor's option, video may also be shot and submitted to supplement the photographs. Videos should be narrated to verbally describe the features being shown. Videos shall be submitted in digital format (on DVD or other storage media).

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

(NOT USED)

END OF SECTION

SECTION 01605

SHIPMENT, PROTECTION, AND STORAGE

PART 1 – GENERAL

1.01 GENERAL

- A. Equipment, products, and materials shall be shipped, handled, stored, and installed in ways which will prevent damage to the items. Damaged items will not be permitted as part of the work except in cases of minor damage that have been satisfactorily repaired and are acceptable to the Construction Manager.
- B. Any factory test required by these specifications shall be performed and submitted to the Construction Manager prior to shipping.

PART 2 – PRODUCTS

2.01 PIPE

- A. Pipe, fittings, pipe supports, air relief valves, valves and appurtenances shall be handled, stored, and installed as recommended by the manufacturer. Pipes with paint, tape coatings, linings, or the like shall be stored to protect the coating or lining from physical damage or other deterioration. PVC pipes that are to be stored for more than seven (7) calendar days shall be protected from direct sunlight (UV) by means of covers or by indoor storage. Pipes shipped with interior bracing shall have the bracing removed only when recommended by the pipe manufacturer.

2.02 REINFORCING STEEL

- A. Reinforcing steel shall be handled, stored and installed as recommended by the manufacturer. Bars shall be stored in a dry place as to minimize exposure to moisture and ocean salt spray. Bars shall be skidded or hoisted from delivery trucks. Timbers shall be located in storage area to assure that bars are not stored in direct contact with earth and kept free of mud. Bundles of bars may be in or on structures, providing the Contractor avoids premature loading or overloading of the structure. Surface protection from rust stains, etc., shall be provided by the Contractor. Bars stored in the open at the site shall be mechanically cleaned and washed prior to installation to remove rust and salt spray.

2.03 GROUT

- A. Grout and other cementitious products shall be handled, stored and installed as recommended by the manufacturer. They shall be stored in a dry place as to minimize exposure to moisture and ocean salt spray. Material in buckets shall remain sealed until ready to use. Material in bags shall be kept in pallets or otherwise off direct contact with the ground. Pulverized material in broken bags may not be used for repair.

2.04 PUMPS, OTHER MECHANICAL AND ELECTRICAL EQUIPMENT, AND INSTRUMENTS

- A. Store and protect pumps, mechanical and electrical equipment, and instrumentation in accordance with the manufacturer's written instructions, inclusive of lubrication especially for items that may be stored for long periods of time prior to installation.

END OF SECTION

SECTION 01660
INSTALLATION, TESTING, AND COMMISSIONING

PART 1 – GENERAL

1.01 DESCRIPTION

- A. This Section specifies the installation, testing, and commissioning for all mechanical, electrical, and instrumentation systems and completed portions of the work, functioning as a completed facility, and the complete project, functioning as a completed facility.

1.02 QUALITY ASSURANCE

- A. Supplier's/Manufacturer's Representative Qualifications: Competent, factory trained, and experienced in the technical applications, installation, operation, and maintenance of respective equipment or system. Representative shall have full authority by the equipment manufacturer to resolve assembly or installation problems at the worksite and issue the certifications required of the manufacturer. Representative subject to acceptance by the Construction Manager. No substitute representatives will be allowed unless prior written approval by such has been given.
- B. Where manufacturer's functional testing services are called for in the Specifications, or when technical assistance is necessary to resolve performance problems that may become apparent during the testing, the manufacturer's representative shall provide such assistance as necessary to demonstrate the specified performance.
- C. Costs for providing services during installation and testing shall be included in the costs for providing the applicable specified equipment.
- D. Where the number of days for services is stated in the Specifications, this shall be considered as the minimum number of days.
- E. Should additional time be required for services, such time shall be at the expense of the manufacturer, supplier, or Contractor as applicable, and at no additional cost to the County.
- F. Warranty of all equipment shall begin at date of final acceptance. Extended warranty shall be provided, if necessary.

1.03 SUBMITTALS

- A. All submittals shall be submitted in accordance with Section 01300 Submittals.

B. Submit the following in the chronological order listed below.

1. Testing, Startup, and Commissioning Plan and Schedule:

- a. Submit the Testing, Startup, and Commissioning Plan at least **60 CALENDAR DAYS** prior to initial testing of the system.
- b. The plan shall include at a minimum:
 - 1) Sequence of testing events for each equipment or system to be tested.
 - 2) Example of forms to be used to document test results for:
 - Factory Testing
 - Functional Testing
 - Operational Testing
 - Commissioning and Acceptance Testing
 - 3) In coordination with the equipment manufacturer, step by step procedures to properly perform equipment Functional Testing including procedures for Pre-Operational Checkout and Installed Tests, list of test parameters, frequency of data collection, and defined successful test criteria.
 - 4) In coordination with County Operational personnel, step by step procedures to properly conduct the Operational Testing with list of test parameters, frequency of data collection, and defined successful test criteria.
 - 5) Description of power, fuel, and chemicals to conduct tests including quantities.
- c. Schedule shall include:
 - 1) Target dates for witness Factory Tests
 - 2) Target date and time for the Construction Manager and the County operations personnel witnessing of each system Functional Testing
 - 3) Target date for initiation of Functional Testing
 - 4) Target date for initiation of Operational Testing

- 5) Target date for initiation of Commissioning and Acceptance Testing
- 6) Schedule shall include holidays observed by the County
 - d. Schedule shall comply with Section 01310 Construction Schedule.
 - e. Schedule shall be submitted until approved.
 - f. Testing shall proceed on a step-by-step basis in accordance with the Contractor's submitted testing plan.
 - g. In addition, at least 60 calendar days prior to any scheduled test date, the Contractor shall submit to the Construction Manager any requests for changes in the proposed testing schedule and details of the installed tests and inspection procedures he/she proposes to adopt for testing and start-up of all equipment to be operated singly and together, include when such procedures have been covered in the Technical Specifications.
2. Manufacturer's representative qualification and resume.
 - a. Submit manufacturer's representative qualifications and resume 60 calendar days after the Notice to Proceed.
3. Test reports and master log:
 - a. Submit report immediately after the completion of the Functional Testing and Operational Testing. Report shall include the following minimum information and as specified in the individual equipment specifications.
 - 1) Date and Time
 - 2) Equipment tested
 - 3) Equipment running during each stage of testing
 - 4) Service conditions – fluid service or application
 - 5) Performance including but not limited to the following:
 - Flow
 - Pressure
 - Level

- Temperature
- Vibrations
- Setpoints
- Quantities or volume
- Weight
- Speed
- Torque
- Concentrations
- Time
- Frequency
- Average
- Voltage
- Resistance
- Amperage

PART 2 – PRODUCTS

(NOT USED)

PART 3 – EXECUTION

3.01 INSTALLATION

A. General

1. All materials, piping, valves, equipment, and appurtenances provided under this contract shall be installed in conformance with the details shown and specified and with the manufacturer's requirements and recommendations.
2. All equipment and apparatus used in testing shall be installed by specialists properly skilled in the trades and professions required to assure first-class workmanship. Where required by detailed specifications, the Contractor shall cause the installation of specific equipment testing items to be accomplished under the supervision of factory-trained installation specialists furnished by the equipment manufacturers. The Contractor shall be prepared to document the skills and training of all workmen engaged in the installation of all testing equipment furnished either by the Contractor or the County.
3. The Contractor shall submit Manufacturer's Installation Certification Form for each model of equipment and Instrument Calibration Certification for each instrument in accordance with Section 01730, "Operation and Maintenance Manuals", before commencing the Commissioning and Acceptance Testing.

3.02 TESTING AND COMMISSIONING

A. General

1. All equipment and partially complete or fully completed portions of the work included in this contract shall be tested and inspected to provide compliance with the contract requirements. Unless otherwise specified, all costs of testing, including temporary facilities and connections, shall be borne by the Contractor. For the purpose of this section, equipment shall mean any mechanical, electrical, instrumentation, or other device with one or more moving parts or devices requiring an electrical, pneumatic or hydraulic connection. Prior to equipment testing, installed leakage tests and other piping tests shall be completed as specified in Divisions 2 and 15, installed tests for electrical devices and systems shall be completed in accordance with Division 16, and installed tests for instrumentation devices and systems shall be completed in accordance with Divisions 13 and 16.
2. Testing equipment, gages, meters, recorders, and monitors shall be provided by the Contractor as required by the County, provided under this contract, to properly demonstrate that all equipment fully satisfies the requirements of this project manual. All devices employed for the purpose of measuring the performance of the facility's equipment and systems shall be specifically selected to be consistent with the variables to be monitored. All instruments shall be calibrated prior to testing and the Contractor shall be prepared at all times to demonstrate, through recalibration, the accuracy of all instruments employed for testing purposes. Calibration procedures shall be in accordance with applicable standards of ASTM, ISA, and IEEE. The adequacy of all gages, meters, recorders, and monitors shall be subject to review of the County.
3. During the Operational Testing period, all equipment and systems in operation shall be operated to the greatest extent practicable, at conditions and in combinations which represent the full range of operating parameters as defined by this contract document.
4. All testing shall be completed in the presence of the Construction Manager or authorized representative.
5. Tests and inspection shall include:
 - a. Factory Testing and delivery inspection.
 - b. Functional Testing and inspections of equipment and components.
 - c. Operational Testing by the Contractor using process water.

- d. Commissioning and Acceptance Testing of the facility by County's personnel with process water.
- 6. Testing procedures shall be designed to duplicate, as nearly as possible, all conditions of operation and shall be carefully selected to ensure that the equipment, piping, valves, and appurtenances are not damaged. Once the testing procedures have been reviewed by the County, the Contractor shall produce checkout, alignment, adjustment and calibration signoff forms for each item of equipment to be used in the field by the Contractor and the County jointly to ensure that each item of electrical, mechanical, and instrumentation equipment has been properly installed and tested. The Contractor is advised that failure to observe these precautions may place the acceptability of the subject equipment in question.
- 7. Tests and inspections, unless otherwise specified or accepted, shall be in accordance with the recognized standards of the industry such as ANSI-HI, AWWA, ASTM, ASME, etc. The Contractor shall see that scheduling and performance of all tests are coordinated with involved subcontractors and suppliers.
- 8. The form of evidence of satisfactory fulfillment of delivery acceptance test and inspection requirements shall be, at the discretion of the County, either by tests and inspections carried out in his/her presence or by certificates or reports of tests and inspections carried out by approved persons or organizations. The Contractor shall provide and use forms which include all test information, including specific operational parameters. The forms used shall be acceptable in content to the County.
- 9. A master test log book shall be maintained by the Contractor which shall cover all tests including piping, valves, equipment, electrical, instrumentation, and appurtenances. The master test log book shall be provided with loose leaf pages which shall be copied daily after updating for transmittal to the County.
- 10. If under test, any portion of the work should fail to fulfill the contract requirements and is adjusted, altered, renewed or replaced, tests on that portion when so adjust, altered, renewed or replaced, together with all other portions of the work as are affected thereby, shall, if so required by the County, be repeated within reasonable time and in accordance with the specified conditions. The Contractor shall pay to the County all reasonable expenses as determined by the Construction Manager incurred by the County as a result of repeating such tests.

11. Once simulated operation has been completed, all machines shall be rechecked for proper alignment, realigned, if necessary, and doweled in place. All equipment shall be checked for loose connections, unusual movement or other indications of improper operating characteristics. Any deficiencies shall be corrected to the satisfaction of the County. All machines or devices which exhibit unusual or unacceptable operating characteristics shall be disassembled and inspected. They shall then be repaired or removed from the site and replaced at no cost to the County.
12. Test results shall be within the tolerances set forth in the detailed specification sections of this contract document, as coordinated with the equipment manufacturer, or as required by the Construction Manager. If no tolerances have been specified, test results shall conform to tolerances established by recognized industry practice. Where, in the case of an otherwise satisfactory installed test, any doubt, dispute, or difference should arise between the County and the Contractor regarding the test results or the methods or equipment used in the performance of such test, then the County may order the test to be repeated. If the repeat test, using such modified methods or equipment as the County may require, substantially confirms the previous test, then all costs in connection with the repeat test will be paid by the County, otherwise the costs shall be borne by the Contractor. Where the results of any installed test fail to comply with the contract requirements for such test, then such repeat tests as may be necessary to achieve the contract requirements shall be made by the Contractor at his/her expense.

B. Factory Tests and Delivery Inspections

1. Test of items at the place of manufacture during and/or on completion of manufacture, comprising hydraulic pressure tests, electric and instrumentation sub-systems tests, performance and operating tests and inspections in accordance with the relevant standards of the industry and more particularly as details in individual clauses of these specifications require in order to satisfy the City that the items tested and inspected comply with the requirements of this contract. The manufacturer shall certify the factory tests.
2. Inspection of all items delivered at the site or to any authorized place of storage in order that the County may be satisfied that such items are of the specified quality and workmanship and are in good order and condition at the time of delivery. The Contractor shall be prepared to remove all coverings, containers, or crates to permit the County to conduct his/her inspection. Should the County find,

in his/her opinion, indication of damage or deficient quality of workmanship, the Contractor shall provide the necessary documentation or conduct such tests deemed necessary by the County to demonstrate compliance.

3. Compensation for tests and work related thereto arising out of this requirement shall be borne by the Contractor.
4. Prepare and submit for approval equipment test report forms. A sample is provided as Form 01660-A, but the form should be revised to be specific to each piece of equipment to be tested.

C. Functional Testing and Inspections

1. All equipment shall pass Factory Testing and Delivery Inspections to the satisfaction of the Construction Manager before the commencement of Operator's training or before any facility or system is put into Functional Testing. Functional Testing shall be as specified herein and shall be made to determine whether the equipment has been properly assembled, aligned, adjusted, and connected. Any changes, adjustments, or replacements required to make the equipment operate as specified shall be carried out by the Contractor as part of the work.
2. Unless otherwise specified, the Contractor shall provide at no expense to the County, all power, water, fuel, compressed air, supplies, labor, and all other necessary items and work required to complete all tests and inspections specified herein. The Contractor shall provide, at no expense to the County, temporary heating, ventilating, and air conditioning for any areas requiring it in the case where permanent facilities are not complete and operable at the time of installed functional tests and inspections. Temporary facilities shall be maintained until permanent systems are in service. Submit a written description in the Testing, Startup, and Commissioning Plan of anticipated temporary utilities and/or facilities that will be necessary as part of the system testing and startup. This list shall indicate quantities, type, duration, estimated delivery dates, and proposed functions of use for each temporary facility or utility.
3. Preparation Checkout: The procedures shall incorporate all requirements of these specifications and shall proceed in a logical, step-wise sequence to ensure that all equipment has been properly serviced, aligned, connected, calibrated, and adjusted prior to installed testing. Preparation checkout procedures shall include, but not be limited to:

- a. Piping system pressure testing and cleaning as specified in Divisions 2 and 15.
 - b. Painting system testing as specified in Division 9.
 - c. Electrical system testing as specified in Division 16.
 - d. Alignment of equipment.
 - e. Preparation lubrication, including provision of all necessary fluids for startup of systems.
4. Installed Functional Test: Once all affected equipment has been subjected to the required pre-operational preparation checkout procedures and the County has witnessed and has not found deficiencies in that portion of the work, individual systems may be started and operated under simulated operating conditions by closed-loop recirculation or other approved methods to determine as nearly as possible whether the equipment and systems meet the requirements of these Specifications.
- a. The intended process fluid or a compatible substitute (supplied by the Contractor) shall be employed for the testing of all liquid systems. Domestic potable, plant water, or non-potable water shall be utilized at the expense of the Contractor in lieu of wastewater for the test.
 - b. Each equipment shall be operated for minimum 2 hours to determine machine operating characteristics, including temperatures and vibration; to observe performance characteristics, and to permit initial adjustment of operating controls and to the satisfaction of the Construction Manager.
 - c. Each equipment shall be run triggering all setpoints and alarms.
 - d. Each equipment shall be cycled through each LOCAL and AUTO operational scenario and mode of operation with each unit, including redundant or spare units.
 - e. All indications at the location and SCADA levels shall be verified. All indications on SCADA shall be verified as visible at Kihei WWRF.
 - f. Submit a copy of Form 01660-A with results of Functional Testing. Retain original for Operational Testing.

D. Operational Testing

1. After completion of all Functional Testing and certification by the County that all equipment complies with the requirements of the specifications, the Contractor shall fill all process units and process systems with the actual service fluid. Domestic potable, plant water, or non-potable water shall be utilized at the expense of the Contractor in lieu of wastewater for the test. The Contractor shall submit all testing reports. Training of County personnel shall be provided as specified herein and Section 01664.
 - a. Upon completion of the filling operations, the Contractor shall introduce flow through the completed portion of the facility for a period of not less than **5 CONSECUTIVE DAYS**, during which all systems shall be operated as a complete facility. Should the Operational Testing period be halted for any reason related to problems with the facilities constructed or the equipment furnished under this contract, or the Contractor's temporary testing systems, the Operational Testing program shall be repeated until the specified continuous period has been completed without interruption. All systems shall be brought to full operating conditions, including temperature, pressure, and flow.
 - b. For equipment with a standby unit, both the duty and standby unit shall be equally tested during the Operational Testing period. Any repair, alteration, corrective action, or unscheduled adjustments to any equipment or systems taken more than 24 hours shall halt the Operational Testing. Any repaired equipment completed within the allowable time frame shall continue to operate for the remaining test period or at a minimum another 48 hours whichever is greater. Any repair or corrective action shall be notified to the Construction Manager, recorded on the event logs, and submitted to the Construction Manager at the end of the Operational Testing period. The Construction Manager reserves the right to accept or deny the repair or corrective action performed by the Contractor.
 - c. Operational Testing shall simulate all operational conditions and scenarios and all combinations of each equipment.
 - d. Operational testing shall also simulate HECO power failure and operate equipment on emergency power.
 - e. All costs for water, fuel, power, and overtime inspections required during this Operational Testing period shall be borne by the Contractor. The Contractor shall supply

operational manpower for 24 hours per day for the duration of the Operational Testing.

- f. The County will provide operational personnel to provide operational decisions affecting the facility performance. The County's assistance will be available only for operational decisions. Contractor will perform all other functions including but not limited to equipment operation and maintenance until successful completion of the Operational Testing period.
 - g. Verify that all SCADA monitoring is visible and all remote-controlled features at Kihei WWRF are functional.
 - h. Unless otherwise specified, Operational Testing shall verify the performance of all equipment as specified in the Quality Assurance paragraphs of each equipment specifications in Division 11, 13, 14, 15, and 16, and that equipment operate together as a system Contractor shall provide test reports for each equipment demonstrating they meet the performance requirements indicated in the technical specifications.
2. Systems shall remain in Operational Testing until it meets the satisfaction of the Construction Manager, and all testing reports have been accepted by the County. Contractor shall continue to pay for temporary operation of the facility including the cost of power, maintenance, fuel, chemicals, filters, media, and other consumables until satisfaction of the Construction Manager has been obtained.

E. Commissioning and Acceptance Testing

1. After submission and approval of the Operational Testing results and reports, the Construction Manager shall issue written notice to proceed with the Commissioning and Acceptance Testing.
2. The commissioning period for all systems shall be **14 CONSECUTIVE DAYS**. The Contractor shall remove all temporary piping, supports, wiring, and other devices that may have been in use during the Operational Testing. All major components and auxiliary components shall be complete as determined by the Construction Manager. Prior to Commissioning, Contractor shall completely re-fill to maximum operational levels all fuel, water, and service fluids consumed during previous testing phases. The County's operations and maintenance personnel will be responsible for operation of the facility or portion of the facility being operated

during this period of time. The system or portion thereof shall be fully operational, accepting normal flow called for in design and performing all functions as designed. In order for Commissioning to begin, the Contractor shall obtain written confirmation from the Construction Manager that all components, testing, and training have been adequately completed; and the facility is ready to commence with commissioning.

- a. The Contractor shall be available at all times during Commissioning periods to provide immediate assistance in case of failure of any portion of the system being tested.
- b. The Construction Manager reserves the right to simulate operational variables, equipment failure, routine maintenance scenarios, etc., to verify the functional integrity and reliability of automatic and manual backup systems and alternate operating modes.
- c. During the Commissioning period, the County shall be responsible for all normal operational costs and the Contractor shall bear the costs of all necessary repairs or replacements, including labor and materials required to keep the portion of the plant being commissioned, operational.
- d. If, during the Commissioning and Acceptance Testing period, the aggregate amount of time used for repair, alteration, or unscheduled adjustments to any equipment or systems that renders the affected equipment or system inoperative exceed 5 percent of the testing period, the demonstration of functional integrity will be deemed to have failed. In the event of failure, a new 14-day Commissioning period will recommence after correction of the cause of failure. The new testing period shall have the same requirements and duration as the testing period previously conducted. If an extended Commissioning period is observed, the Construction Manager reserves the right to require the Contractor to either replace or completely refill consumable items including but not limited to fuel, chemicals, filters, and media.
- e. At the end of the Commissioning period and when all corrections required by the County to assure a reliable and completely operational facility are complete, the County shall issue a certificate of substantial completion. The County reserves the right to not issue substantial completion if it is determined that other essential portions of the work have not been completed.

3.03 MEASUREMENT AND PAYMENT

- A. The cost of work within this specification shall be paid for by the lump sum item Startup, Testing, and Commissioning in the Proposal.

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SECTION 01664

TRAINING

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section contains requirements for training the County's personnel, by persons retained by the Contractor specifically for the purpose, in the proper operation and maintenance of the equipment and systems installed under this contract.

1.02 GENERAL

- A. Where required by the detailed specifications, the Contractor shall provide on-the-job training of the County's personnel. Training for each piece of equipment shall be conducted by qualified, experienced (2 years minimum), factory-trained representatives of the various equipment manufacturers. Training shall include instruction of operating personnel in equipment operation and preventive maintenance and instruct plant mechanics, electricians, and electronics technicians in normal maintenance up to major repair.
- B. Where specified in Division 15 the Contractor shall conduct training sessions for the County's operation and maintenance personnel to instruct the staff on the proper operation, care, and maintenance of the equipment and systems installed under this contract. Training shall take place at the site of the work and under the conditions specified in the following paragraphs. Approved equipment operation and maintenance manuals shall be available to County personnel at least 30 days prior to the date scheduled for the individual training session.

1.03 SUBMITTALS

- A. The following information shall be submitted to the Construction Manager in accordance with the provisions of Section 01300. Due to phased testing and start-up activities, separate submittals can be prepared for each system or process. The material shall be reviewed and accepted by the Construction Manager no later than three (3) weeks prior to delivery of the training. Training will not be accepted without County approval of the training submittal.
 - 1. Lesson plans for each training session to be conducted by the Contractor's trainer and/or manufacturer's representatives. In addition, training manuals, handouts, visual aids, and other reference materials shall be included.

2. Training manuals and/or handouts shall include (a) student notes such that student note taking is minimized to allow the student to concentrate on the instruction; and (b) legible copies of the visual aids to allow the student to annotate their notes directly on the copy of the visual aid as it is being discussed; and (c) other resource material listed hereinafter.
3. Date, time, and subject of each training session and identity and qualifications of individuals to be conducting the training.
4. Training schedule: Concurrent classes will not be allowed.

1.04 TRAINING LOCATION

- A. Field training sessions shall take place at the site of the equipment. Classroom training shall take place in the training room in the Operations Building, at the Kihei Wastewater Reclamation Facility.

1.05 QUALITY ASSURANCE

- A. The manufacturer's representative shall have a minimum of **5 years** of operational and maintenance experience with the specific equipment prior to the Notice to Proceed.
- B. The County reserves the right of representative rejection and alternative substitution rejection if the representative's qualifications are considered inadequate as determined by the Construction Manager. The County also reserves the right to interview the representative, at least by telephone, to confirm the representative's qualifications. The Contractor shall be responsible for the coordination and cost of these interviews.

PART 2 - PRODUCTS

2.01 LESSON PLANS

- A. Each lesson plan is intended to provide a detailed training program for a system or process. The lesson plans will be used in the future by the County's training staff for training new employees and providing refresher courses for experienced personnel.
- B. Formal written lesson plans shall be prepared for each training session. Lesson plans shall contain a detailed lesson plan following the format provided in Exhibit 01664-1, Lesson plan. The content of the lesson plan shall include the services listed in Paragraph 3.02. One complete set of originals of the lesson plans, training manuals, handouts, visual aids, and reference material shall become the property of the County and shall be suitably bound for proper organization and easy reproduction. The Contractor shall furnish

one (1) PDF copy and fifteen (15) copies of necessary training manuals, handouts, visual aids and reference materials at least 1-week prior to each training session.

2.02 FORMAT AND CONTENT

- A. Each training session shall be comprised of time spent both in the classroom and at the specific location of the subject equipment or system. As a minimum, a training session shall cover the following topics for each system or process:
1. Familiarization/orientation
 2. Safety
 3. Operation and controls
 4. Troubleshooting
 5. Preventive Maintenance
 6. Corrective Maintenance
 7. Parts
 8. Local Representatives
 9. Operation and Maintenance Manuals

2.03 VIDEO RECORDING

- A. Furnish audio and visual recording of all instruction sessions, including manufacturers' representatives' hands-on equipment instruction and classroom sessions.

On-site training sessions shall be recorded for video submission to the Owner. The Contractor shall retain the services of a commercial video taping service to record each training session. After taping, the material will be edited and supplemented with professionally produced graphics to provide a permanent record. The Contractor shall advise all manufacturers providing training sessions that the material will be video taped and shall make available to the video taping contractor such utility services and accommodation as may be required to facilitate the production of the video tape record.

1. Video recording audio and visual must be clear, to the extent possible. Recording shall not have background noise i.e. wind, traffic or conversation not pertinent to the discussion.
2. All statements made by the instructor shall be provided in "closed caption" on the final recording. Questions asked during the training and responses shall be provided in "closed caption" questions on the final recorded and submitted video. Editing the response for clarification is acceptable.

3. Contractor must provide a microphone to record both the presenter and questions from the audience.
 4. Microphone must be able to eliminate background noise.
- B. Use DVD format suitable for playback on standard equipment available commercially in the United States. Blu-ray® DVD format is not acceptable without Construction Manager's prior approval.
- C. Include one training session on each DVD. DVD may contain multiple training sessions. If multiple training sessions included on a DVD, provide with on-screen menu for playback selection.

2.04 PRODUCT DATA

- A. Product data to be provided under this section, shall be one (1) PDF copy, the original and three (3) copies of standard operating procedures (SOPs) and standard maintenance routines (SMRs) for all equipment that requires training. SOPs and SMRs will be jointly developed by the Contractor and the Manufacturer and field tested during the equipment mechanical and electrical testing phase and during the acceptance testing phase of this project.
- B. SOPs shall be provided for start-up, shutdown, and other procedures that are routinely required for operation of the equipment. SOPs shall be specific to the equipment for which they are provided. They may be prepared during testing by recording in detail, the steps followed during start-up, operation, and shutdown of the equipment being tested.
- C. SMRs shall be provided for all preventative maintenance activities listed in Section 01999. The County has a catalog of SMRs they currently follow. The Contractor may review the catalog and identify existing SMRs that are applicable to equipment supplied under this contract. New SMRs shall be prepared where existing SMRs are not available.

PART 3 - EXECUTION

3.01 GENERAL

- A. Training shall be conducted in conjunction with the operational testing and commissioning periods. Classes shall be scheduled such that classroom sessions are interspersed with field instruction in logical sequence. The Contractor shall arrange to have the training conducted on consecutive days.
- B. The acceptable days for training operations personnel are Tuesday, Wednesday, and Thursday, unless more than 3 consecutive days are

needed. Training for mechanics and electrical staff may be scheduled for Monday through Friday. Each training session shall be conducted twice to permit training of one-half of the County's staff at a time.

- C. Acceptable operation and maintenance manuals, as defined in Section 01730, for the specific equipment shall be provided to the County at least 30 days prior to the start of any training. If the County chooses to videotape, the taping shall take place concurrently with training sessions.
- D. The Contractor shall provide the following training resources and handouts to the O&M personnel during the classes:
 - 1. Drawings and photographs of equipment.
 - 2. Equipment O&M manual information.
 - 3. Equipment manufacturer's information, such as factory shop manuals, factory fabrication drawings, and circuit diagrams.
 - 4. Erection and/or installation drawings and procedures.

3.02 REQUIRED SERVICES

- A. The following services shall be provided for each item of equipment or system as required in individual specification sections. Additional services shall be provided, where specifically required in individual specification sections.
- B. As a minimum classroom equipment training for operations personnel will include:
 - 1. Using POWERPOINT and drawings, discuss the equipment's specific location in the plant and an operational overview.
 - 2. Purpose and plant function of the equipment.
 - 3. A working knowledge of the operating theory of the equipment.
 - 4. Start-up, shutdown, normal operation, and emergency operating procedures, including a discussion on system integration and electrical interlocks, if any. Instructor shall use the prepared SOP as the basis for this discussion.
 - 5. Identify and discuss safety items and procedures.
 - 6. Routine preventative maintenance, including specific details on lubrication and maintenance of corrosion protection of the equipment and ancillary components.
 - 7. Operator detection, without test instruments, of specific equipment trouble symptoms.
 - 8. Required equipment exercise procedures and intervals.
 - 9. Routine disassembly and assembly of equipment if applicable (as judged by the County on a case-by-case basis) for purposes such as operator inspection of equipment.

C. As a minimum, hands-on equipment training for operations personnel will include:

1. Identify location of equipment and review the purpose.
2. Identifying piping and flow options.
3. Identifying valves and their purpose.
4. Identifying instrumentation:
 - a. Location of primary element.
 - b. Location of instrument readout.
 - c. Discuss purpose, basic operation, and information interpretation.
5. Discuss, demonstrate, and perform SOPs and round checks
6. Discuss and perform SMRs and other preventative maintenance activities.
7. Discuss and perform start-up and shutdown procedures.
8. Perform the required equipment exercise procedures.
9. Perform routine disassembly and assembly of equipment if applicable.
10. Identify and review safety items and perform safety procedures, if feasible.

D. Classroom equipment training for the maintenance and repair personnel will include:

1. Theory of operation.
2. Description and function of equipment.
3. Start-up and shutdown procedures.
4. Standard SMR and major repair procedures.
5. Equipment inspection and troubleshooting procedures including the use of applicable test instruments and the "pass" and "no pass" test instrument readings.
6. Routine and long-term calibration procedures.
7. Safety procedures.
8. Preventive maintenance such as lubrication; normal maintenance such as belt, seal, and bearing replacement; and up to major repairs such as replacement of major equipment part(s) with the use of special tools, bridge cranes, welding jigs, etc.

E. Hands-on equipment training for maintenance and repair personnel shall include:

1. Locate and identify equipment components.
2. Review the equipment function and theory of operation.
3. Review standard maintenance procedures (SMR)
4. Perform start-up and shutdown procedures.
5. Review and perform the safety procedures.

6. Perform County approved practice maintenance and repair job(s), including mechanical and electrical adjustments and calibration and troubleshooting equipment problems.
- Disassemble, perform detailed repairs, and assemble. If this is not feasible to be done at the project site, the Manufacturer has the option of (1) conducting hands-on training on equivalent equipment, as judged by the County at another facility of the County or (2) creating a factory videotape of disassembly, detailed repairs, and assembly. This video tape will then be shown to the County's O&M personnel in lieu of "live" hands-on training for disassembly, detailed repairs, and assembly. In order to provide for questions and answers, a qualified instructor will be in attendance when the videotape is shown. The videotape shall become the property of the County and shall be turned over to the County.
 - Review and use equipment manufacturer's manuals in the hands-on training.
- F. The Contractor shall provide, at their own expense, any consumable materials required for the hands-on equipment training. If the instructor or students consume items from the equipment's spare parts as stipulated in this specification, then the Contractor shall replenish the items consumed.

3.03 TRAINING NEEDS

- A. The following is a consolidation of all equipment items or systems for which the Contractor is required to provide training.

Section No.	Description	Training Days (Minimum)
11303	Submersible Wastewater Pumps	1
11304	Odor Control System	1
13214	Aboveground Fuel Tank	0.5
15800	Heating, Ventilation, and Air Conditioning	0.5
16235	Emergency Generator	1
16924	Variable Frequency Drives	0.5
17010	Instrumentation and Controls	1
19321	SCADA	1
Various	Other Electrical Improvements	0.5
Various	General Pump Station Operation	1

- B. A training day is defined as at least five hours of student-instructor contact time per day for classroom training or at least 4 hours 30 minutes of student-instructor contact time per day for hands-on training. A training day occurs between 8 a.m. and 3 p.m.

- C. Submit Form 01664-A, Manufacturer's Instruction Certification Form, upon completion of training.

END OF SECTION

SECTION 01700

RESTORATION OF IMPROVEMENTS

PART 1 – GENERAL

1.01 STRUCTURES

The Contractor shall take all precautions necessary to protect the integrity and usefulness of all existing facilities. If necessary, the Contractor may, with the approval of the Construction Manager, remove such existing structures, including curbs, gutters, pipelines and utility poles as may be necessary for the performance of the work, and shall rebuild the structures thus removed in as good a condition as found with the requirements specified. He shall also repair existing structures which may be damaged as a result of the work under this contract.

1.02 ROADS AND STREETS

Unless otherwise specified, roads and streets in which the surface is removed, broken, or damaged, or in which the ground has caved or settled during the work under this contract, shall be resurfaced and brought to the original grade and section. Roadways used by the Contractor shall be cleaned and repaired. Before resurfacing material is placed, edges of pavements shall be trimmed back far enough to provide clean, solid, vertical faces, and shall be free of loose material. All paved surfaces shall be cut with a pavement saw. Rough cuts are not allowed. Repair work shall conform to the standard specifications for paving.

1.03 CULTIVATED AREAS AND OTHER SURFACE IMPROVEMENTS

Cultivated or planted areas and other surface improvements which are damaged by actions of the Contractor shall be restored as nearly as possible to their original condition in accordance with Standard Specification Section 50--Soil Preparation and Section 51--Planting Trees, Shrubs, Ground Cover and Grass. Restoration shall take place within 1-week or sooner as directed by the Construction Manager. Existing guard posts, barricades, and fences shall be protected and replaced if damaged.

1.04 PROTECTION OF EXISTING INSTALLATIONS

The Contractor shall protect all existing operating facilities and structures from damages. However, if damage occurs, the Contractor shall immediately correct or replace existing equipment, controls, systems, structures, or facilities which are damaged in any way as a result of his operations.

PART 2 – PRODUCTS

(NOT USED)

PART 3 – EXECUTION

(NOT USED)

END OF SECTION

SECTION 01710

FINAL CLEANUP

PART 1 - GENERAL

1.01 GENERAL

The Contractor shall thoroughly clean each work area and equipment provided under their Contracts including but not limited to the removal of all equipment and debris, including all dirt, sand, gravel, rubbish and waste material from the project site. Should the Contractor not remove rubbish or debris or not clean the site as specified, the County reserves the right to have the cleaning done at the expense of the Contractor.

1.02 SITE CLEANUP

The Contractor shall have the sidewalks and streets affected by the work swept by a street or sidewalk cleaner as determined by the Construction Manager. Other surfaces of the grounds shall be rake cleaned. The County will not authorize final payment until the Contractor has removed all rubble and debris from the street and adjoining work areas, including all temporary storage and parking areas used by the Contractor.

All temporary utility drops, fencing, and water supply outlets, if used, shall be removed.

All site access and project identification signs, barricades, tools, rubbish collection receptacles and other such items shall be removed by the Contractor.

PART 2 – PRODUCTS

(NOT USED)

PART 3 – EXECUTION

(NOT USED)

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SECTION 01720

RECORD DRAWINGS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The Contractor shall maintain two (2) sets of neatly marked full-size set of Contract and shop drawings which show the actual installed condition, layout and dimensions of completed work. These drawings shall include information about all new or modified piping, conduit, structures, and facilities.
- B. Buried and concealed work such as piping, duct banks, conduits and cables shall have burial depth and horizontal and vertical dimensions to permanent surface improvements and GPS coordinate points shown on the drawings.
- C. The primary purpose of these as-built documents is to provide accurate information for the future operation, maintenance, and modification of the facilities. It is especially important to record the actual installed conditions for concealed systems, and materials. Typical concealed systems include, but are not limited to, piping, conduit, and cable.

1.02 PERFORMANCE REQUIREMENTS

- A. Record documents shall show the actual installed conditions of the Contractor installed or modified systems, piping and material at the time of acceptance of the related portions of the work.

1.03 GIS/GPS REQUIREMENTS

- A. Contractor shall be responsible for recording the GPS Coordinates of all buried and concealed work to be dedicated to the County and provide the GPS data to the County prior to the project's final acceptance. An accurate GPS point every 50 feet along the main line, at utility crossings, and at any installed appurtenance (including but not limited to manholes, bends, concrete jacket, cleanout, pipe deviations, change in pipe size, critical joints, ARV, etc.).
- B. GPS data shall be in NAD 1983 State Plane Hawaii 2 FIPS 5102 grid and shall be accurate to within 1-foot. Acquired GPS survey data shall be quality checked by the contractor prior to submission in shapefile (.shp) format, for compatibility with mainstream GIS software such as ESRI ArcMap.

- C. Ductbanks and Electrical Boxes: An accurate GPS point every 50 linear feet and at each bend or deviation along the line. Additional points shall be taken at each service manhole and vaults.
- D. Force Mains: An accurate GPS point every 50 linear feet and at each bend or deviation along the line. Additional points shall be taken at each ARV, concrete jackets, critical joints, thrust blocks, utility crossings, changes in pipe size and/or type, and any other appurtenances.
- E. Gravity Sewer Lines and Manholes: An accurate GPS point at every manhole, cleanout, lateral connection point, utility crossings, concrete jackets, and at each bend or deviation along the line.
- F. Underground Structures: An accurate GPS point at every corner, at every 50 feet (max) along the perimeter, and major utility penetration of the structure.
- G. Accuracy: All GPS data shall be at least within 1-foot accuracy.

1.04 RELATED WORK

- A. Other specification sections contain additional as-built document requirements. As-built documents are required to be submitted and accepted by the Construction Manager prior to the work or portions of the work being considered substantially complete.
- B. Other Contractor supplied documents which shall be submitted in as-built condition shall include operation and maintenance instructions (see Section 01730, "OPERATING AND MAINTENANCE INFORMATION") and test results (see Section 01660, "INSTALLATION, TESTING AND COMMISSIONING").

1.05 SUBMITTALS

- A. In accordance with Section 01300, "SUBMITTALS," and in addition to the requirements of that section, the as-built documents submittals shall include:
 1. Contract Documents
 2. Contract supplemental drawings
 3. Change order drawings
 4. GIS Data
- B. The Contractor shall submit the two (2) full-size marked-up documents to the Construction Manager for review, approval, and use.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

3.01 GENERAL

- A. Two (2) full-sized set of drawings shall be updated to current conditions daily using the mark-up procedure detailed hereinafter. These field record drawings shall be maintained in a clean, dry, and legible condition. Record documents shall not be used for construction purposes and shall be available for review by the Construction Manager during normal working hours at the Contractor's field office. Monthly and final payments to the Contractor shall be subject to prior approval of the drawings. At the completion of the work, prior to final payment, both sets of record drawings shall be submitted to the Construction Manager.
- B. Whenever existing process piping, electrical conduit or ductbanks, water mains, sewers, or other utilities are exposed during construction, the locations and elevations of these utilities shall be measured and recorded on the as-built drawings. Locations and sizes of electrical conduit and conductor embedded within concrete structures shall be recorded on the electrical plan record drawings. This field verified data of existing utilities shall be designated on the as-built drawings by a standard symbol to be selected by the Construction Manager. Field verified dimensions shall be required on all exposed existing utilities even if no other work is required on these facilities.

3.02 STANDARDS

- A. All revisions and additions to drawings shall be designated with a numbered balloon callout symbol on the drawing which references a corresponding note. The callout notes shall be shown in a vertical column on the right side of the drawing. The callout note shall indicate the nature and extent of the revision or addition and the date the note was recorded.

B. Documents shall be marked using the following color code.

Additions--red
Deletions--green
Comments--blue
Dimensions—black

END OF SECTION

SECTION 01730

OPERATING AND MAINTENANCE INFORMATION

PART 1 – GENERAL

1.01 DESCRIPTION

- A. Operation and Maintenance (O&M) information shall be provided in accordance with this section and as required in the technical sections of the Project Manual. O&M information shall be provided for each maintainable piece of equipment, equipment assembly or subassembly, and material provided or modified under this contract.
- B. O&M information must be submitted and accepted 30 days before on-site training may start.

1.02 TYPES OF INFORMATION REQUIRED

A. GENERAL:

- 1. O&M information shall contain the names, addresses, and telephone numbers of the manufacturer, the Hawaii or nearest representative of the manufacturer, and the nearest supplier of the manufacturer's equipment and parts. In addition, one or more of the following items of information shall be provided as applicable.
- B. Operating Instructions: Specific instructions, procedures, and illustrations shall be provided for the following phases of operations:
 - 1. Safety Precautions: List personnel hazards for equipment list safety precautions for all operating conditions.
 - 2. Operator Pre-Start: Provide requirements to set up and prepare each system for use.
 - 3. Startup, shutdown, and post-shutdown procedures/
 - 4. Normal Operations: Provide control diagrams with data to explain operation and control and specific equipment.
 - 5. Emergency Operations: Provide emergency procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Include emergency shutdown instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance on emergency operations of all utility systems including valve locations and portions of systems controlled.
 - 6. Operator Service Requirements: Provide instructions and time schedule for services to be performed by the operator such as lubrication, adjustments, and inspection to maintain life of equipment.

7. Environmental Conditions: Provide a list of environmental conditions (temperature, humidity, and other relevant data) which are best suited for each product or piece of equipment and describe conditions under which equipment should not be allowed to run.
- C. Preventative Maintenance: The following information shall be provided for preventive and scheduled maintenance to minimize corrective maintenance and repair:
 1. Lubrication Data: Provide lubrication data, in addition to instructions, including the following:
 - a. A table showing recommended lubricants for specific temperature ranges and applications.
 - b. Charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities.
 - c. A lubrication schedule showing service interval frequency.
 2. Preventative Maintenance Plan and Schedule: Provide manufacturer's schedule for routine preventive maintenance, inspections, tests, and adjustments required to ensure proper and economical operation and to minimize corrective maintenance and repair. Provide manufacturer's projection of preventive maintenance man-hours on a daily, weekly, monthly, and annual basis including craft requirements by type of craft.
- D. Corrective Maintenance: Manufacturer's recommendations shall be provided on procedures and instructions for correcting problems and making repairs.
 1. Troubleshooting Guides and Diagnostic Techniques: Provide step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or requires replacement.
 2. Wiring Diagrams and Control Diagrams: Wiring diagrams and control diagrams shall be point-to-point drawings of wiring and control circuits including factory-field interfaces. Provide a complete and accurate depiction of the actual job-specific wiring and control work. On diagrams, number electrical and electronic wiring and pneumatic control tubing and the terminals for each type identically to actual installation numbering.
 3. Maintenance and Repair Procedures: Provide instructions and list tools required to restore product or equipment to proper condition or operating standards.
 4. Removal and Replacement Instructions: Provide step-by-step procedures and list required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances,

- dimensions, settings, and adjustments required. Instructions shall include a combination of test and illustrations.
5. Spare Parts and Supply Lists: Provide lists of spare parts and supplies required for maintenance and repair to ensure continued service or operation without unreasonable delays. Special consideration is required for facilities at remote locations. List spare parts and supplies that have a long lead time to obtain.
 6. Corrective Maintenance Manhours: Provide manufacturer's projection of corrective maintenance man-hours including craft requirements by type of craft. Corrective maintenance that requires participation of the equipment manufacturer shall be identified and tabulated separately.
- E. **Appendices:** The following information shall be provided; include information not specified in the preceding paragraphs but pertinent to the maintenance or operation of the product or equipment.
1. Parts Identification: Provide identification and coverage for all parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Include special hardware requirements, such as requirement to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustrations and separate listing shall show the index, reference, or key number which will cross-reference the illustrated part to the listed part. Parts shown in the listings shall be grouped by components, assemblies, and subassemblies.
 2. Warranty Information: List and explain the various warranties and include the servicing and technical precautions prescribed by the manufacturers or project manual to keep warranties in force.
 3. Personnel Training Requirements: Provide information available from the manufacturers to use in training designated personnel to operate and maintain the equipment and systems properly.
 4. Testing Equipment and Special Tool Information: Provide information available from the manufacturers to use in training designated personnel to operate and maintain the equipment and systems properly.

1.03 TRANSMITTAL PROCEDURES

- A. Unless otherwise specified, O&M manuals, information, and data shall be transmitted in accordance with Section 01300 accompanied by Transmittal Form 01730-A and Equipment Record Forms 01730-B and/or 01730-C, as appropriate, all in Section 01999. The transmittal form shall be used as a checklist to ensure the manual is complete. Only complete sets of O&M instructions will be reviewed for acceptance.

- B. Refer to the transmittal schedule in Section 01300 and the various sections of these specifications for guidance as to required O&M submittals.
- C. A pdf copy and five (5) copies of the specified O&M information shall be provided. For ease of identification, each manufacturer's brochure and manual shall be appropriately labeled with the equipment name and equipment number as it appears in the specifications. The information shall be organized in the binders in numerical order by the equipment numbers assigned in the Project Manual. The binders shall be provided with a table of contents and tab sheets to permit easy location of desired information. Binders shall be hard covered, 3-hole loose leaf.
- D. If manufacturers' standard brochures and manuals are used to describe O&M procedures, such brochures and manuals shall be modified to reflect only the model or series of equipment used on this project. Extraneous material shall be crossed out neatly or otherwise annotated or eliminated.

PART 2 – PRODUCTS

(NOT USED)

PART 3 – EXECUTION

3.01 FIELD CHANGES

- A. Following the acceptable installation and operation of an equipment item, the item's instructions and procedures shall be modified and supplemented by the Contractor to reflect any field changes or information requiring field data.

3.02 DELIVERY

- A. Acceptable O&M information for the project must be delivered to the Officer-in-Charge prior to the project being 65 percent complete. Progress payments for work in excess of 65 percent completion will not be made until the specified acceptable O&M information has been delivered to the Officer-in-Charge.

END OF SECTION

SECTION 01999

REFERENCE FORMS

The forms listed below and included in this section are referenced from other sections of the project manual:

<u>Form No.</u>	<u>Title</u>
01300-A	Submittal Transmittal Form *
n/a	Progress and Payment Estimate Report Form *
n/a	Act 68 of 2010, Contractor Self-Certification Form
n/a	Request for Information Form
n/a	Change Order Work by Force Account Form *
n/a	Certification Form 1, Apprenticeship Program Preference (Act 17 of 2009)
n/a	Certification of Compliance with HRS 396-18, Safety and Health Program for Contracts in excess of \$100,000
01660-A	Equipment Test Report Form
01664-A	Manufacturer's Instruction Certification Form
01730-A	Operation and Maintenance Manual Transmittal Form
01730-B	Manufacturer's Installation Certification Form

* Form available in electronic format upon request.

01300-A

SUBMITTAL TRANSMITTAL

Submittal Description: _____

Submittal No¹: _____

Spec Section: _____

	Routing	Sent	Received
OWNER: County of Maui, DEM/WWRD, Maui, Hawaii	Contractor/CM		
PROJECT:	CM/Engineer		
	Engineer/CM		
CONTRACTOR:	CM/Contractor		

We are sending you ~ Attached ~ Under separate cover via_____

Remarks:

Item	Copies	Date	Section No.	Description	Review Action ^a	Review comments attached

^aNote: NET = No exceptions taken; MCN = Make corrections noted; A&R = Amend and resubmit; R = Rejected

Attach additional sheets if necessary.

Certify either A or B:

- ~ A. We have verified that the material or equipment contained in this submittal meets all the requirements, including coordination with all related Work, specified or shown (no exceptions).
- ~ B. We have verified that the material or equipment contained in this submittal meets all the requirements specified or shown except for the attached deviations.

No.	Deviation
_____	_____
_____	_____

Certified by: _____
Contractor's Signature

¹See Paragraph 01300-2.02, Transmittal Procedure.

CONSTRUCTION PROGRESS AND PAYMENT ESTIMATE REPORT

TO: WWRD, County of Maui
2200 Main Street, Suite 610
Wailuku, HI 96753

Date _____

CONTRACT NO. _____
COUNTY JOB NO. _____

PROJECT: _____
PAYMENT ESTIMATE NO.: _____
FOR THE MONTH OF: _____
CONTRACTOR: _____
ADDRESS: _____

CONTRACT INFORMATION		WORK ACCOMPLISHED
ORIGINAL CONTRACT	0 _____	WORK COMPLETED TO DATE: _____
		LESS 5% RETAINAGE: _____
		TOTAL AMOUNT SUBJECT TO PAYMENT: _____
		PREVIOUS ESTIMATES: _____
		PAYMENT NOW DUE: _____
TOTAL REV CONTRACT _____		
NOTICE TO PROCEED DATE: _____		ORIG. CONTRACT PERIOD: _____
ORIG. CONTR. COMPL. DATE: _____		REV. CONTRACT PERIOD: _____
REV. CONTR. COMPL. DATE: _____		% CONTRACT TIME ELAPSED: _____
		% PROJECT COMPLETE: _____

CHECKED:	APPROVED FOR PAYMENT:
Project Engineer, WWRD	Department of Finance
RECOMMENDED:	
Chief, Wastewater Reclamation Division	I certify that the above bill is correct and just and that payment has not been received.
APPROVED:	
Director of Environmental Management	Contractor

ACT 68 of 2010: Certification for Employment of State Residents on Construction Procurement Contracts

Date

Director of Finance
County of Maui
200 South High Street
Wailuku, HI. 96793

Subject: [insert project name and contract number]

As required by of Act 68, SB 2840, Employment of State Residents on Construction Procurement Contracts, (2010), I hereby certify under oath, that for the month of _____, 20____, Hawaii Residents composed not less than eighty percent (80%) of the workforce employed to perform on the subject Contract and all subcontracts to the subject Contract that are \$50,000 or more.

CORPORATE SEAL
(IF APPLICABLE)

CONTRACTOR

(Name of Contractor)

(Signature)

(Print Name)

(Print Title)

(Date)

STATE OF _____) SS

COUNTY OF _____)

The foregoing Certification, Employment of State Residents on Construction Procurement Contracts, dated _____ 20____, was subscribed and sworn to before me, this _____ day of _____ 20____, in the State of _____.

(Signature)

(Print Name)

Notary Public, State of _____
My commission expires: _____

COUNTY OF MAUI
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
WASTEWATER RECLAMATION DIVISION

REQUEST FOR INFORMATION

RFI NO.: _____ DATE: _____

PROJECT: _____ PROJECT NO. _____

SUBJECT: _____

CONTRACTOR: _____ ADDRESS _____

CONSULTANT: _____ ADDRESS _____

WWRD PM: _____ ADDRESS _____

TYPE OF REQUEST: CLARIFY () CONFLICT () DISCREPANCY () SUGGEST () OTHER ()

SPEC. SECTION: _____ PLAN REF. / DETAIL: _____

PROBLEM:

IS THERE A COST? YES () NO () ESTIMATE: \$_____

ATTACHMENTS: BACKUP () SKETCH ()

COPY SENT TO: CONSULTANT () PROJECT ENGINEER () OTHER () _____

SOLUTION:

BY: _____ TITLE: _____ DATE: _____

COST ESTIMATE: _____

ATTACHMENTS: COST EST () BACKUP ()
COPY SENT TO: CONSULTANT () PROJECT ENGINEER () OTHER () _____

SHEET ____ OF ____

COUNTY OF MAUI
WASTEWATER RECLAMATION DIVISION

CHANGE ORDER BY FORCE ACCOUNT - SECTION 00710 GENERAL CONDITIONS SECTION 11.4

Contract No.: _____
 Job No.: _____
 Date : _____
 Report No.: _____

Project: _____
 Contractor: _____
 Sub-Contractor (Y/N): _____ For Profit and Bond Calculation Per 11.4(7) and 11.4(8)
 Prepared by: _____
 Work Performed: _____

LINE	General Conditions	Description	Markup	Calculations	PCM Price	Notes
1	11.4(1)	Invoice price of all supplied materials (Direct Cost)		Attach Worksheet		
2	11.4(2)	Labor Cost (Direct Cost)		Attach Worksheet		
3	11.4(3)	Overhead (Indirect Costs)	10%	10% of Line 2	\$ -	
4	11.4(4)	Equipment (Direct Cost)		Attach Worksheet		
5	11.4(5)	Labor Burden (Direct Cost)	33%	Percentage of Line 2		The cost of workers' compensation, public liability premiums, unemployment tax, social security tax, or other taxes on the labor.
6	11.4(6)	Profit - Material, Labor, OH & Equip.	15%	15% of Sum of Lines 1 to 4	\$ -	No Markup on Line 5 - Labor Burden
7	11.4(7)	Markup for Sub Work :	5.000%	Up to 5% Provided Profit + OH do not exceed 20% DC	\$ -	
8	11.4(7)	Max Sub Markup Check :		PROFIT:	\$ -	
9		20% Direct Costs :	\$ -			
10		OH + Profit :	\$ -	OK		
11		SUBTOTAL:		Sum Lines 1-5 and 8	\$ -	
12	11.4(8)	Bond Fee (On Contractor's Gross Earnings)	1%	Up to 1% of Line 11. Applies to Contractor Only.	\$ -	\$0 for Sub-Work
13	11.4(9)	Hawaii G. E. T. (4.166 %)	4.166%	Tax on Sum Lines 11, 12	\$ -	
14				Sum Lines 11-13	\$ -	TOTAL FORCE ACCOUNT PRICE

Approved/Contractor _____

Approved/County of Maui _____

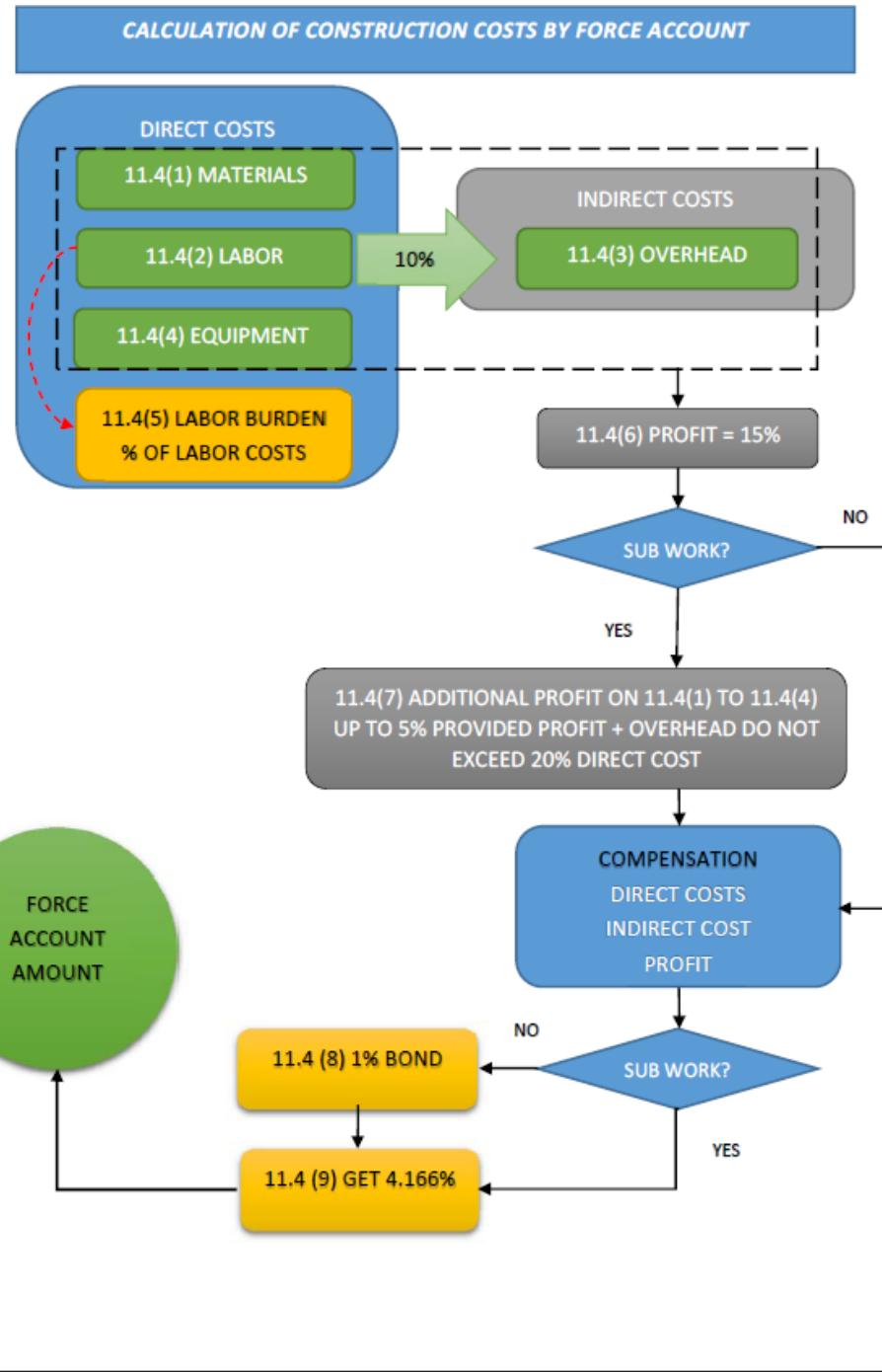
Attachments :

- Worksheet 1 - Material Costs
- Worksheet 2 - Labor Costs
- Worksheet 3 - Equipment Costs

NOTES:

Electronic Worksheet (Excel) available Upon Request

COUNTY OF MAUI
WASTEWATER RECLAMATION DIVISION
CHANGE ORDER BY FORCE ACCOUNT – SECTION 00710 GENERAL CONDITIONS SECTION 11.4



FORM 1

CERTIFICATION OF BIDDER'S PARTICIPATION IN APPROVED APPRENTICESHIP PROGRAM UNDER ACT 17

I. Bidder's Identifying Information			
A. Business Name: _____			
B. Project Bid Reference No.: _____			
C. Contact Person's Name: _____			
1. Phone No.: _____		2. E-Mail: _____	
II. Apprenticeable Trades To Be Employed A. (List)		B. Apprenticeship Sponsor (One Sponsor Per Form)	
1.			
2.			
3.			
4.			
5.			
6.			
III. Bidder's Certification I certify that the above information is accurate to the best of my knowledge. I understand that my willful misstatement of facts may cause forfeiture of the preference under Act 17 and may result in criminal action. I give permission for outside sources to be contacted and for them to disclose any information necessary to verify the bidder's preference.			
A. Name (Type) _____		B. Title _____	
C. Signature _____		D. Date _____	
IV. Apprenticeship Sponsor's Contact Information			
A. Training Coordinator's Name: _____		B. Address: _____	
C. Phone No.: _____		D. E-Mail: _____	E. Fax No: _____
V. Apprenticeship Program Sponsor's Verification I certify that the above information is accurate to the best of my knowledge. I understand that my willful misstatement of facts may cause forfeiture of the bidder's preference and may result in criminal action. I give permission for outside sources to be contacted and for them to disclose any information necessary to verify the bidder's preference under Act 17.			
A. Name of Authorized Official _____		B. Title _____	
C. Signature _____		D. Date _____	

(06/15/2010)

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**CERTIFICATION OF COMPLIANCE
WITH HRS 396-18, SAFETY AND HEALTH PROGRAMS
FOR CONTRACTOR BIDDING ON COUNTY JOBS IN EXCESS OF \$100,000**

PROJECT NAME AND NUMBER _____

This is to certify that the undersigned will comply with the requirements of HRS 396-18, as follows:

- (A) Pursuant to HRS 396-18, all bids and proposals in excess of \$100,000 shall include a signed certification from the bidder that a written safety and health plan for the job will be available and implemented by the notice to proceed dates of the project. The written safety and health plan shall include:
- (1) A safety and health policy statement reflecting management commitment;
 - (2) A description of the safety and health responsibilities of all levels of management and supervisors on the job and a statement of accountability appropriate to each;
 - (3) The details of:
 - (a) The mechanism for employee involvement in job hazard analysis;
 - (b) Hazard identification, including periodic inspections and hazard correction and control.
 - (c) Accident and "near-miss" investigations; and
 - (d) Evaluations of employee training programs;
 - (4) A plan to encourage employees to report hazards to management as soon as possible and to require management to address these hazards promptly; and
 - (5) A certification by a senior corporate or company manager that the plan is true and correct.
- (B) Failure to submit the required certification may be grounds for disqualification of the bid.
- (C) Failure to have available on site or failure to implement the written safety and health plan by the project's notice to proceed date shall be considered willful noncompliance and be sufficient grounds to disqualify the award and terminate the contract.

Name of Contractor

Signature and Title

Date: _____

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NOTE: This example equipment test report is provided for the benefit of the Contractor and is not specific to any piece of equipment to be installed as a part of this project. The example is furnished as a means of illustrating the level of detail required for the preparation of equipment test report forms for this project.

CITY OF SAMPLE**EXAMPLE WATER TREATMENT PLANT STAGE
IV EXPANSION PROJECT**

ABC Construction Company, Inc., General Contractor XYZ
Engineering, Inc., Construction Manager

EQUIPMENT TEST REPORT

Equipment Name: Sludge Pump 2
 Equipment Number: P25202
 Specification Ref: 11390
 Location: East Sedimentation Basin Gallery

	Contractor		Construction Manager	
	Verified	Date	Verified	Date
PRE-OPERATIONAL CHECKLIST				
<u>Mechanical</u>				
Lubrication				
Alignment				
Anchor bolts				
Seal water system operational				
Equipment rotates freely				
Safety guards				
Valves operational				
Hopper purge systems operational				
Sedimentation tank/hopper clean				
O&M manual information complete				
Manufacturer's installation certificate complete				
<u>Electrical</u> (circuit ring-out and high-pot tests)				
Circuits:				
Power to MCC 5				
Control to HOA				
Indicators at MCC:				
Red (running)				
Green (power)				

01660-A.

EQUIPMENT TEST REPORT FORM

Amber (auto)				
Indicators at local control panel				
Wiring labels complete				
Nameplates:				
MCC				
Control station				
Control panel				
Equipment bumped for rotation				
Piping Systems				
Cleaned and flushed:				
Suction				
Discharge				
Pressure tests				
Temporary piping screens in place				
Instrumentation and Controls				
Flowmeter FE2502F calibration				
Calibration Report No.				
Flow recorder FR2502G calibrated against transmitter				
VFD speed indicator calibrated against independent reference				
Discharge overpressure shutdown switch calibration				
Simulate discharge overpressure Shutdown				
FUNCTIONAL TESTS				
Mechanical				
Motor operation temperature satisfactory				
Pump operating temperature satisfactory				
Unusual noise, etc?				
Pump operation: 75 gpm/50 psig				
Measurement:				
Flow:				
Pressure:		Test gage number:		
Alignment hot				
Dowelled in				
Remarks:				
		Contractor	Construction Manager	
		Verified	Date	Verified Date
Electrical				
Local switch function:				

01660-A.

EQUIPMENT TEST REPORT FORM

Runs in <i>HAND</i>			
No control power in <i>OFF</i>			
Timer control in <i>AUTO</i>			
Overpressure protection switch PS2502C functional in both <i>HAND</i> and <i>AUTO</i>			
Overpressure protection switch PS2502C set at 75 psig			
PLC 2500 set at 24-hour cycle, 25 min <i>ON</i>			
OPERATIONAL TEST			
48-hour continuous test. Pump cycles as specified, indicators functional, controls functional, pump maintains capacity, overpressure protection remains functional, hour meter functional			

RECOMMENDED FOR BENEFICIAL OCCUPANCY

Construction Manager _____ Date _____

ACCEPTED FOR BENEFICIAL OCCUPANCY

Owner's Representative _____ Date _____

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01664-A. MANUFACTURER'S INSTRUCTION CERTIFICATION FORM

Contract No: _____ Specification section: _____

Equipment name: _____

Contractor: _____

Manufacturer of equipment item: _____

The undersigned manufacturer certifies that a service engineer has instructed the wastewater treatment plant operating personnel in the proper maintenance and operation of the equipment designated herein.

<u>Operations Check List (check appropriate spaces)</u>	
Start-up procedure reviewed	
Shutdown procedure reviewed	
Normal operation procedure reviewed	
Others:	
<u>Maintenance Check List (check appropriate spaces)</u>	
Described normal oil changes (frequency)	
Described special tools required	
Described normal items to be reviewed for wear	
Described preventive maintenance	
Described greasing frequency	
Others:	

Date _____

Manufacturer _____

Signature of Authorized Representative

Date _____

Signature of Owner's Representative

Date _____

Signature of Contractor's Representative

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01730-A. OPERATION AND MAINTENANCE MANUAL TRANSMITTAL FORM

Date: _____

Submittal No:¹ _____

To: _____

Contract No: _____

Spec. Section: _____

Submittal Description: _____

From: _____

Attention: _____

Checklist	Contractor		Construction manager	
	Satisfactory	N/A	Accept	Deficient
1. Table of contents				
2. Equipment record forms				
3. Manufacturer information				
4. Vendor information				
5. Safety precautions				
6. Operator prestart				
7. Start-up, shutdown, and postshutdown procedures				
8. Normal operations				
9. Emergency operations				
10. Operator service requirements				
11. Environmental conditions				
12. Lubrication data				
13. Preventive maintenance plan and schedule				
14. Troubleshooting guides and diagnostic techniques				
15. Wiring diagrams and control diagrams				
16. Maintenance and repair procedures				
17. Removal and replacement instructions				
18. Spare parts and supply list				
19. Corrective maintenance man-hours				
20. Parts identification				
21. Warranty information				
22. Personnel training requirements				
23. Testing equipment and special tool information				

Remarks: _____

Contractor's Signature

¹See SP 140, Drawings to be Furnished by Contractor.

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01730-B. MANUFACTURER'S INSTALLATION CERTIFICATION FORM

Contract No: _____ Specification section: _____

Equipment name: _____

Contractor: _____

Manufacturer of equipment item:

The undersigned manufacturer of the equipment item described above hereby certifies that he has checked the installation of the equipment and that the equipment, as specified in the project manual, has been provided in accordance with the manufacturer's recommendations, and that the trial operation of the equipment item has been satisfactory.

Comments: _____

Date

Manufacturer

Signature of Authorized Representative

Date

Contractor

Signature of Authorized Representative

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SECTION 02050

DEMOLITION

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Provide all demolition required to perform the work covered under this contract including without limitation:
 1. Remove existing construction shown to be removed.
 2. Remove and replace existing construction and/or finishes as required to provide access to perform other work included in this contract.
 3. Include removal of mechanical and electrical work that is to be abandoned and is contained in construction to be removed whether or not the mechanical and electrical work is shown. Disconnect and cap off utilities in accordance with applicable codes and safety regulations.
 4. Where utilities that are not shown pass through construction that must be removed and those utilities serve other areas notify the Construction Manager before disrupting service. If rerouting is required to maintain service, the County may issue a Change Order to accomplish the required work.
 5. Store and protect items intended for reuse.
 6. Assume ownership of debris and unwanted materials, remove from the site, and dispose of legally.
 - a. Special requirements for waste management during construction operations.
 - 1) Protect the environment, both onsite and offsite, during construction operations.
 - 2) Prevent environmental pollution and damage.
 7. If the presence of a hazardous material, is suspected, have material tested. If material is identified as hazardous, retain qualified and licensed specialist to remove and dispose of it legally.
 8. If illegal electrical wiring is encountered such as "BX" or nonmetallic sheathed cable, notify the Construction Manager.
 9. Remove and properly dispose of unwanted fixed equipment, including and without limitation to unwanted equipment and devices built into or attached to the structure to be demolished. Remove all loose items including rubbish, debris, etc.

1.02 NOISE AND DUST CONTROL

- A. Perform work in accordance with requirements in Division 1.

- B. Provide temporary safety barriers as specified by drawings or Project Manual to exclude unauthorized persons.
- C. Perform work in a manner to cause least damage to work to remain.
- D. Maintain adequate means of safe access to sidewalks along side boundary for general public.
- E. Employ all available techniques for construction noise abatement. Use remote, well-muffled air compressors and newest noise suppressed pneumatic and electric tools.

1.03 WARNING

- A. The Contractor is advised that work under this Section may be hazardous. The Contractor is to take all necessary precautions to ensure the safety of workers and property. Removal of and/or working in areas containing even minor amounts of hazardous material including without limitation, asbestos, lead-based paint, PCBs or other hazardous materials requires special precautions, knowledge, and procedures. If hazardous material is suspected, notify the Construction Manager.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

3.01 REMOVAL OF CONSTRUCTION IN AREAS TO RECEIVE NEW WORK

- A. In areas intended to receive new work and/or finishes, remove all unwanted improvements and finishes.
- B. Remove all unwanted mechanical and electrical work (whether shown or not) that is not wanted and is not needed to serve other areas that is in, on, or concealed behind work being removed. Cap off or terminate all mechanical or electrical work in accordance with the requirements of Divisions 15 and 16.
- C. Protect mechanical and electrical work that serves other areas. Relocate concealed mechanical and electrical work that is required to preserve service to other areas.
- D. Remove structural work designated for removal. Take precautions not to damage structural work intended to remain. Where temporary shoring is

needed, submit a design prepared by an appropriately licensed engineer for review before proceeding.

- E. If structural elements are encountered that were not shown, protect them from damage and report their presence to the Construction Manager.

3.02 REMOVAL OF LIMITED PORTIONS OF EXISTING CONSTRUCTION TO PERMIT MODIFICATIONS

- A. Provide careful, selective cutting and removal of existing construction as required to permit relocation or modification of openings. Cut and remove the least amount of work possible except when a larger area needs to be removed to permit strengthening existing construction or when required to remove finishes to a natural break line such as a corner or change in material.
- B. Protect existing construction to remain with temporary coverings.
- C. Treat existing mechanical, electrical, or structural work as described in other parts of this Section.
- D. When modifications are complete, replace removed work with new construction and finishes to match adjacent existing work. Standards of material and workmanship shall be in accordance with other portions of this Specification or if not covered then in accordance with current practice for this class of work. Salvaged materials may be used for replacement if in good condition.

3.03 REMOVAL OF EXISTING CONSTRUCTION TO PROVIDE ACCESS TO PERFORM WORK

- A. Provide careful selective cutting and removal of existing construction where required to permit installation of new concealed mechanical or electrical work, or installation of equipment, fixtures or devices.
- B. Treat existing mechanical, electrical, or structural work as described in other parts of this Section.
- C. Replace and/or patch removed construction and finishes in accordance with other parts of this Section.

3.04 PROTECTION OF WORK TO REMAIN

- A. Protect all work to remain. Repair damage with materials, workmanship, and finishes matching existing work when new.

3.05 CUTTING HOLES IN CONCRETE AND/OR CONCRETE MASONRY UNIT (CMU)

- A. The Contractor is cautioned that electrical conduits and reinforcing that are not shown on Drawings may be concealed in concrete CMU construction. Use electronic detection equipment to locate concealed items before cutting holes. Take all required precautions to avoid damage to existing conduits or reinforcing.
- B. New openings in existing concrete walls or slabs may be saw cut to opening perimeter lines where Drawings do not call for adding reinforcing trim bars to strengthen openings. Do not run saw kerfs past corners of openings. Complete concrete removal at opening corners by chipping and grinding. Take all required precautions to avoid water damage to existing construction or the County's property.
- C. Where Drawings call for adding reinforcing trim bars to strengthen openings, limit saw cutting to a depth of 3/4 inch to avoid cutting existing reinforcing steel. Carefully chip out concrete to avoid damaging existing reinforcing steel which is to remain.
- D. Use chipping guns to chip out small holes for pipes or conduits. Proceed carefully to avoid damage to concealed conduits. Core drilling is permitted only at the Contractor's risk and only with the Construction Manager's permission. If core drilling is used, the Contractor shall: 1) use electronic detection equipment to locate conduit before drilling; 2) take precaution to avoid water damage to existing construction or the County's property; and 3) replace, at its own expense, any damaged electrical or signal wiring or conduits.

3.06 REMOVE UNWANTED FIXED EQUIPMENT

- A. Remove unwanted fixed and built-in equipment whether shown or not. Cut off protruding bolts or attachment devices flush with existing surfaces.
- B. If items are designated on the Drawings to be salvaged, remove them carefully without causing damage. Deliver items to be turned over to the County to the County's storage facility at Kihei WWRF located at 480 E. Welakahao Road, Kihei, HI 96753. Delivery to be coordinated with the Construction Manager.
- C. Store and protect items to be reused until time of need on jobsite.

3.07 IF HAZARDOUS MATERIALS ARE ENCOUNTERED

- A. If hazardous materials are discovered, comply with paragraph 1.01 of this Section and all applicable laws.

3.08 REMOVAL AND DISPOSAL OF MATERIAL

- A. Store debris in suitable covered containers located where directed by the Construction Manager and remove from site when full. Burning on the site is not permitted.
- B. Removed material (other than material to be reused) shall become the property of the Contractor who shall remove it from the site and dispose of it in a legal manner.

END OF SECTION

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SECTION 02300

EARTHWORK

PART 1 - GENERAL

1.01 SUMMARY

A. SECTION INCLUDES:

1. Perform all excavation, shoring, dewatering, backfilling, compaction, and grading necessary or required for the construction of the work as covered by these Specifications and indicated on the Drawings. The excavation shall include, without classification, the removal and disposal of all materials of whatever nature encountered, including water and all other obstructions that would interfere with the proper construction and completion of the required work.

1.02 REFERENCES

A. ASTM INTERNATIONAL (ASTM):

ASTM C136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
ASTM D448	Standard Classification for Sizes of Aggregate for Road and Bridge Construction.
ASTM D698	Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft ³).
ASTM D1556	Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
ASTM D1557	Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb/ft ³).
ASTM D1883	Standard Test Method for California Bearing Ratio (CBR) of Laboratory-Compacted Soils.
ASTM D2167	Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
ASTM D2487	Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
ASTM D2844	Standard Test Method for Resistance R-Value and Expansion Pressure of Compacted Soils.
ASTM D2922	Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

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|------------|---|
| ASTM D3017 | Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth). |
| ASTM D4253 | Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table. |
| ASTM D4254 | Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density. |
| ASTM D4318 | Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils. |
- B. Specific sections of the STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION, DEPARTMENT OF PUBLIC WORKS, CITY AND COUNTY OF HONOLULU, COUNTY OF KAUAI, MAUI AND HAWAII (hereinafter referred to as "Standard Specifications") dated September 1986 and STANDARD DETAILS FOR PUBLIC WORKS CONSTRUCTION, CITY AND COUNTY OF HONOLULU, COUNTY OF KAUAI, MAUI AND HAWAII (hereinafter referred to as "Standard Details") dated September 1984 as revised, except as amended in the plans and/or specifications herewith. (Paragraphs concerning Measurements).
- C. Specific sections of the WATER SYSTEM STANDARDS, CITY AND COUNTY OF HONOLULU, COUNTY OF KAUAI AND MAUI (hereinafter referred to as "Water Standards") dated 2002 as 1984 as revised, except as amended in the plans and/or specifications herewith. (Paragraphs concerning Measurements).

1.03 DEFINITIONS

- A. **Site:** Property owned by County of Maui, Wastewater Reclamation Division, as shown on the Drawings.
- B. **Engineered Fill:** Engineered Fill may be Imported Soil or Native Soil that has been processed to meet the requirements specified herein.
- C. **Fill:** Earth used to fill holes, pits, or depressions necessary to bring the final grade up to the specified elevation or contours.
- D. **Pipe Zone:** Zone of material that extends from 10 inches below the pipe to up to 12 inches above the crown of the pipe. See Drawings for more information.
- E. **Pipe Bedding:** Zone of material that extends from the bottom of the pipe to 10 inches below the pipe.
- F. **Trench Zone:** Zone of material that extends from the top of the pipe zone to the "Final Backfill" zone, which is the bottom of the pavement subgrade in pavement areas or finished grade in earth, landscape, and gravel areas.

- G. **Rock Excavation**: Excavation of material that consists of boulders and pieces of concrete or masonry exceeding 1 cubic yard in dimension which, in the opinion of the Engineer, requires for its removal, drillings and blasting, wedging, sledging or barring, breaking up with a power operated hand tool, or hydraulic hammer attachment on a backhoe or excavator.
- H. **Relative Compaction**: In-place dry density divided by the maximum dry density laboratory compaction expressed as percentage.
- I. **Landscape Fill**: Imported or native soil free from deleterious materials, salts, weeds, or other materials harmful to plant growth with a pH range of 5.5 to 7 (ASTM D5268) and a minimum of 4 percent organic material content. Clay, silt, and/or sand content less than 60 percent by mass.
- J. **Native Soil**: Remove rocks or lumps larger than 3 inches in greatest dimension and be free of organics (less than 3 percent organic material by weight), debris, and other deleterious materials. Do not use wet, soft, or frozen material, organic matter, asphalt chunks, or other deleterious substances as backfill.
- K. **Subgrade**: Zone of material that is improved to create a stable, suitable platform for subsequent layers.
- L. **Structural Backfill**: Material placed over subgrade, below structures, as backfill around structures, or as indicated on the Drawings.
- M. **Aggregate Base**: Refer to section 02700

1.04 SUBMITTALS

- A. Submit in accordance with Section 01300.
- B. **SUBMITTALS FOR INFORMATIONAL PURPOSES:**
 - 1. **Excavation Protection Plan**: Identify location, extent, and type of excavation protection. Describe sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property; include structural calculations for cuts 20 feet, or greater, to support plan. Structural calculations for cuts 20 feet, or greater, shall be done under the supervision of a Professional Engineer experienced in the design of this Work and licensed in the State of Hawaii.
 - a. **Environmental Protection Plan**: Refer to Section 01140
- C. **PRODUCT DATA:**
 - 1. Potholing Report.
 - 2. Gradation report(s) for bedding material and import backfill materials.

3. Compaction Reports.
- D. SAMPLES AND TEST RESULTS:

1. Furnish, without additional cost to the County, such quantities of bedding material and/or import materials as may be required by the Construction Manager for test purposes. Cooperate with the Construction Manager and furnish necessary facilities for sampling and testing of all materials and workmanship. Tests shall be performed within 60 days of the submission. All material furnished and all work performed shall be subject to rigid inspection. Submit test results following product review submittal requirements. No material shall be delivered to the site until it has been favorably reviewed by the Construction Manager. No material shall be used in construction work until it has been inspected in the field by the Construction Manager.

1.05 QUALITY ASSURANCE

- A. Source Quality Control: Furnish all bedding material from a single source throughout the work unless otherwise approved. Test import materials proposed for use demonstrating that the materials conform to the specified requirements. Submit results to the Construction Manager prior to delivery. Tests shall be performed by an independent testing laboratory.
- B. Field Quality Control:
1. The Contractor shall hire an independent third-party Geotechnical Engineer to provide the following quality control measures related to flatwork, pipeline installation, non-structural fill, or other items not requiring special inspection as outlined under Special Inspections:
 - a. Review materials proposed for use.
 - b. Observe foundations, site grading, and borrow operations.
 - c. Observe placement and compaction of fill.
 - d. Test soils during placement of fill.
 2. Contractor shall excavate holes for in-place soil sampling. Contractor shall be responsible for costs of additional inspection, rework, and re-testing resulting from non-compliance.
 3. Material that does not meet the gradation, quality, or compaction requirements shall be removed and replaced with material that does comply at no cost to the County.
- C. Special Inspections:

1. The County will be responsible for special inspections in accordance with applicable County building code and the Drawings. Special inspection is required for work related to constructing buildings, structures, structural work, and roadways, and includes but is not limited to:
 - a. Verifying materials below foundations are adequate to achieve the design bearing capacity requirements.
 - b. Verifying excavations are to the depth identified in the Contract Documents and the bottom of excavations are suitable materials.
 - c. Perform classification and testing of compacted fill materials.
 - d. Verifying materials meet quality, lift thickness, and in-place density requirements specified herein.
 - e. Prior to placement of compacted fill, inspect subgrade and verify the site has been prepared properly.
2. Testing will be performed at the frequency provided or as otherwise established by the County prior to Construction:
 - a. Engineered Fill: Test every 500 square feet for each 2 feet of fill.
 - b. Subgrade: Test every 200 square feet where in-place materials have been disturbed and recompacted or as recommended by the Engineer.
 - c. Structural Backfill: Test every 200 square feet of building footprint, with no less than two tests per structure. Test every 200 cubic yards of material placed within 10 feet around the building.
 - d. Aggregate Base: Test every 500 square feet of each layer

D. Testing Methods:

1. Testing shall conform to the requirements of the HDOT Standard Specifications.
2. Conduct sampling and testing in accordance with HDOT TM 1-00 through HDOT TM 8-00.
3. Competent personal to complete testing shall be certified under the Field Sampling and Testing Qualification Program (FSTQP).

1.06 DELIVERY, STORAGE AND HANDLING

- A. Scheduling of deliveries shall be coordinated with the Owner's representative prior to material arriving onsite so as not to interrupt activities.
- B. Earthwork materials shall be stored in a location confirmed in writing by the Owner's representative. Written approval from the Owner's representative shall be provided if alternative storage locations are to be used.

1.07 SUBSURFACE INVESTIGATIONS

- A. While the records of data obtained, including any geotechnical investigations and/or reports, may be considered by the Contractor to be correct, any conclusions or recommendations made in the reports are for information to the Design Engineer and are not a part of the Contract Documents. Copies of the boring and test pit logs are included as an Attachment to these Specifications.

1.08 ADDITIONAL SAFETY RESPONSIBILITIES

- A. The Contractor shall select, install, and maintain shoring, sheeting, bracing, and sloping as necessary to maintain safe excavations. The Contractor shall be responsible for ensuring such measures: (1) comply fully with 29 CFR Part 1926 OSHA Subpart P Excavations and Trenches requirements; (2) provide necessary support to the sides of excavations; (3) provide safe access to the Construction Manager's sampling and testing within the excavation; (4) provide safe access for backfill, compaction, and compaction testing; and (5) otherwise maintain excavations in a safe manner that shall not endanger property, life, health, or the project schedule. All earthwork shall be performed in strict accordance with applicable law, including local ordinances, applicable OSHA/HIOSH requirements.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Backfill: Backfill may be Native Backfill or Imported Backfill unless otherwise called out on the plans, provided that all backfill materials meet the requirements herein.
- B. Imported Fill Material: Imported fill materials shall be material conforming to the specifications herein. Imported fill shall be well-graded, non-expansive select granular material with a maximum particle size of 3 inches, and between 10 and 30 percent of particles by weight shall pass the #200 sieve. In addition, the material shall have a laboratory CBR value of 20 or more and

- a maximum swell of 1 percent or less when tested in accordance with ASTM D1883.
- C. **Onsite Fill Material:** Onsite soils consisting of non-expansive granular materials free of vegetation, deleterious materials, and clay lumps and rock fragments greater than 3 inches in maximum dimension may be acceptable for reuse in compacted fills and backfills but shall not be used in the base course section below structural foundations.
 - D. **Pipe Cushion:** Pipe Cushion material shall be per Water Standards, paragraph 209.02.A.
 - E. **Pipe Bedding:** Standard Specifications Section 21 – PVC Sewer Pipe and Appurtenances.
 - F. **Crushed Rock:** Standard Specifications Section 15 – Crushed Rock.
 - G. **Water:** The water used shall be reasonably free of objectionable quantities of silt, oil, organic matter, alkali, salts and other impurities. Water quality must be acceptable to the Construction Manager.
 - H. **Base Course:** Refer to section 02700.
 - I. **Warning Tape:** 3-inch-wide, inert, fade-resistant plastic film resistant to acids, alkalies, and other components likely to be encountered in soil. Tape installed above recycled water mains shall be purple, imprinted with "CAUTION RECLAIMED/RECLAIMED WATER LINE BURIED BELOW". Tape installed above sanitary sewer piping shall be green, imprinted with "CATION SEWER LINE BURIED BELOW".

PART 3 - EXECUTION

3.01 GENERAL CONSTRUCTION REQUIREMENTS

- A. **Site Access:** Access to the site will be over public and private roads. Exercise care in the use of such roads and repair at own expense any damage thereto caused by Contractor's operations. Such repair shall be to the satisfaction of the Construction Manager or agency having jurisdiction over the road. Take whatever means are necessary to prevent tracking of mud onto existing roads and shall keep roads free of debris.
- B. **Traffic Regulation:** Provide such flagmen, patrols, pilot cars, drivers, lighted barricades, flares, lights, warning signs, and safety devices as may be required for control of traffic adjacent to all areas of work.
- C. **Barriers:** Barriers shall be placed at each end of all excavations and at such places along excavations as may be necessary to warn all pedestrian and

- vehicular traffic of such excavations. Lights shall also be placed along excavations from sunset each day to sunrise of the next day until such excavation is entirely restored.
- D. Access: Free access must be maintained to all fire hydrants, water valves and meters, and driveways.
 - E. Dust Control: Take proper and efficient steps to control dust.
 - F. Storage of Materials: Excavated materials unsuitable for backfill shall not be stored on existing streets and shall be disposed of immediately. Neatly place excavated materials far enough from the excavation to prevent stability problems. Keep the materials shaped to cause the least possible interference with site operations and drainage.
 - G. Maintain access to firefighting equipment and to fire hydrants.

3.02 CONTROL OF WATER

- A. All excavations shall be kept free from water and all construction shall be in the dry.
 - 1. It should be presumed that the presence of groundwater will require dewatering operations. Furnish, install, maintain, and operate all necessary pumping and other equipment for dewatering all excavations. At all times, have on the project sufficient pumping equipment for immediate use, including standby pumps for use in case other pumps become inoperable.
 - 2. Provide a sufficient number of pumps so as to hold the groundwater level at an elevation of not less than 1-foot below the lowest elevation of the pipe, structure, or other material to be placed.
 - 3. Dispose of water in such a manner as to be in compliance with regulatory requirements and cause no injury or nuisance to public or private property or be a menace to the public health.
 - 4. The dewatering operation shall be continuous, so that the excavated areas shall be kept free from water during construction, while concrete is setting and achieves full strength, and until backfill has been placed to a sufficient height to anchor the work against possible flotation.
 - 5. Continue dewatering during backfilling operations such that the groundwater is at least 1-foot below the level of the compaction effort at all times. No compaction of saturated materials will be allowed.

- 6. Dewatering devices must be adequately filtered to prevent the removal of fines from the soil.
- B. The Contractor shall be responsible for any damage to the foundations or any other parts of existing structures or of the new work caused by failure of any part of the Contractor's protective works. After temporary protective works are no longer needed for dewatering purposes, they shall be removed by the Contractor.
- C. If pumping is required on a 24-hour basis, requiring engine drives, then engines shall be equipped in a manner to keep noise to a minimum.
- D. Prevent disposal of sediments from the soils to adjacent lands or waterways by employing whatever methods are necessary, including settling basins.
- E. The Contractor shall not discharge any water from dewatering into the sewer system.
- F. The Contractor shall be responsible for furnishing temporary drainage facilities to convey and dispose of surface water falling on or passing over the site.

3.03 EXISTING UTILITIES

- A. General: The known existing buried utilities and pipelines are shown on the Drawings in their approximate location. The Contractor shall exercise care in avoiding damage to all utilities as he will be held responsible for their repair if damaged. There is no guarantee that all utilities or obstructions are shown, or that locations indicated are accurate. Utilities include piping, conduits, wire, cable, ducts, manholes, pull boxes and the like, located at the project.
- B. Check on Locations (Potholing): Contact all affected utility owners and request them to locate their respective utilities prior to the start of "potholing" procedures. The utility owner shall be given a minimum of 7 days written notice prior to commencing potholing. If a utility owner is not equipped to locate its utility, the Contractor shall locate it.
- C. Clearly paint the location of all affected utility underground pipes, conduits and other utilities on the pavement or identify the location with suitable markers if not on pavement. In addition to the location of metallic pipes and conduits, non-metallic pipe, ducts and conduits shall also be similarly located using surface indicators and shall then be similarly marked.
- D. After the utility survey is completed, commence "potholing" to determine the actual location and elevation of all utilities where crossings, interferences, or connections to new pipelines or other facilities are shown on the Drawings, marked by the utility companies, or indicated by surface signs. Prior to the

preparation of piping shop drawings, or the excavating for any new pipelines or structures, the Contractor shall locate and uncover these existing utilities to a point 1-foot below the utility.

- E. Excavations around underground electrical ducts and conduits shall be performed using extreme caution to prevent injury to workmen or damage to electrical ducts or conduits. Similar precautions shall be exercised around gas lines and telephone cables.
- F. Interferences: If interferences occur at locations other than shown in the Drawings, the Contractor shall notify the Construction Manager, and a method for correcting said interferences shall be supplied by the Construction Manager. Payment for interferences that are not shown on the plans, nor which may be inferred from surface indications, shall be in accordance with the provisions of the General Conditions. If the Contractor does not expose all required utilities prior to shop drawing preparation, he shall not be entitled to additional compensation for work necessary to avoid interferences, nor for repair to damaged utilities.
- G. Any necessary relocations of utilities, whether shown on the Drawings or not, shall be coordinated with the affected utility. The Contractor shall perform the relocation only if instructed to do so in writing from the utility and the Construction Manager.

3.04 SITE AND STRUCTURE EXCAVATION

- A. Remove lumped subsoil and rock up to $\frac{1}{2}$ cubic yard, measured by volume. Remove larger material as specified in Paragraph 3.06 Rock Excavation.
- B. The maximum allowable temporary slope during excavation range is 1 1/2H:1V up to 20 feet vertically.
- C. Excavate to the dimensions and elevations indicated in the Drawings or specified herein. Include proper working methods, the erection of forms, and the protection of the work in excavation extents.
- D. Take care to not remove rock beyond the dimensions and elevations required for structures. Over-ripping may disrupt the structure of the rock formation and result in potential bearing strength loss. Follow the requirements of "Excavation Beyond the Limits Indicated" if such over-ripping occurs.
- E. Inspection of Excavation: Notify the Engineer when excavation for the structure is complete. Excavation must be inspected and approved by the Engineer prior to installing forms, reinforcing steel, concrete, or precast structures.

3.05 TRENCH EXCAVATION

- A. Excavation for pipe and other utilities such as duct banks shall be in open cut. The trench shall be as wide as necessary for sheeting and bracing and the proper performance of the work up to the maximum width permitted by the typical cross-sections shown on the Drawings. The sides of the trenches shall be vertical in paved areas. The bottom of the trench shall be constructed to the grades and shapes indicated on the Drawings. Favorable review by the Construction Manager is required prior to use of alternative methods of construction.
- B. Take care not to over excavate. Accurately grade the bottom of the trenches to provide uniform bearing and support for each section of the pipe or conduit at every point along its entire length, except for the portions of the pipe sections where it is necessary to excavate for bell holes and for the proper sealing of pipe joints, and as hereinafter specified. Dig bell holes and depressions for joints after the trench bottom has been graded. For the pipe to rest on the bedding for as nearly its full length as practicable, bell holes and depressions shall be only of such length, depth, and width as required for properly making the joint. Remove stones as necessary to avoid point bearing.
- C. The trench shall not be backfilled until the Construction Manager reviews the pipe and bedding installation.
- D. Backfill and compact over excavations in accordance with the requirements of paragraph 3.11 with structural backfill. There shall be no additional payment to the Contractor for over excavations not coordinated with the Construction Manager. Remove unsatisfactory material encountered below the grades shown as directed by the Construction Manager and replace with structural backfill. Payment for removal and replacement of such unsatisfactory material coordinated with the Construction Manager shall be made in accordance with the provisions of the General Conditions.
- E. Grade trenches so that they are uniformly sloped between the pipe elevations shown on the Drawings. If no elevations are shown on the Drawings, provide 3 feet of minimum cover. Comply with the minimum and maximum trench widths shown on the Drawings. Notify the Construction Manager if the trench width exceeds the maximum allowable width for any reason.
- F. For all piping or conduits to be placed in any excavated and backfilled area, such as at manholes or for building connections, the structural backfill shall be first compacted to a level at least 3 feet from the top of the piping or conduit elevation and then retrenched to pipe grade.
- G. Provide ladders for access to the trench by construction and inspection personnel.

3.06 ROCK EXCAVATION

- A. Exercise caution during excavations involving basalt rock formations to avoid over-ripping. Chipping and/or use of hoe ram/hydraulic breaker may be utilized to remove materials to desired elevation.
- B. No soft or disintegrated rock which can be removed with a hand pick or power operated excavator or shovel; no loose, shaken, or previously blasted rock or broken stone in rock fillings, or elsewhere; and no rock exterior to the minimum limits of measurement allowed, which may fall into the excavation, will be measured or allowed.

3.07 SUPPORT OF EXCAVATIONS

- A. Adequately support excavation for trenches and structures to meet all applicable requirements in the current rules, orders, and regulations. Excavation shall be adequately shored, braced, and sheeted so that the earth will not slide or settle and so that all existing structures and all new pipe and structures will be fully protected from damage. Keep vehicles, equipment, and materials far enough from the excavation to prevent instability.
- B. Take all necessary measures to protect excavations and adjacent improvements from running, caving, boiling, settling, or sliding soil resulting from the high groundwater table and the nature of the soil excavated.
- C. The support for excavation shall remain in place until the pipeline or structure has been completed. During the backfilling of the pipeline or structure, the shoring, sheeting, and bracing shall be carefully removed so that there shall be no voids created and no caving, lateral movement, or flowing of the subsoils.

3.08 EXCAVATION BEYOND THE LIMITS INDICATED

- A. Do not to excavate beyond the limits shown in the Drawings or as specified herein.
- B. If excavation beyond the limits indicated occurs, backfill with material approved by the Engineer and compact as specified herein.
- C. There is no additional payment for such work.

3.09 UNSTABLE OR UNSATISFACTORY SOILS

- A. If the bottom of the excavation is soft or unstable, and in the opinion of the Engineer cannot satisfactorily support the pipe, structure, or other related design elements, the Engineer will determine proper corrective methods.

Payment for removal and replacement or other corrective methods shall be made in accordance with the provisions of the General Conditions.

3.10 SUBGRADE PREPARATION

- A. Prepare subgrade to a minimum depth of 6 inches from the bottom of excavation.
- B. Finished Subgrade: Finished subgrade material may be native soil or import material and prepared to be non-yielding when proof-rolled by passing over all areas to receive fill or as required by the Engineer with a minimum 10-ton roller, front-end loader with loaded bucket, or other heavy rubber-tired vehicle with high tire pressure (e.g., loaded tandem dump truck), in the presence of the Engineer.
- C. Fill Subgrade: Fill Subgrade (prior to placement of any fill material) may be native soil or import material prepared to be non-yielding when proof-rolled by passing over all required areas with a minimum 10-ton roller, front-end loader with loaded bucket, or other heavy rubber-tired vehicle with high tire pressure (e.g., loaded tandem dump truck) in the presence of the Engineer.
- D. If the subgrade is unstable, wet, or soft, coordinate with the Engineer for corrective methods prior to placing subsequent lifts.

3.11 SITE AND TRENCH BACKFILL

- A. Site Backfill:
 1. Do not place any backfill material until the Engineer has inspected, tested and favorably reviewed the prepared subgrade.
 2. Construct fills as shown on the Drawings, true to line, grade, and cross-section.
 3. Construct fills of native soil or imported soil. Place material in uniform, level layers, not exceeding 6 inches thick measured before compaction.
- B. Trench Backfill:
 1. Place bedding and backfill materials true to the lines, grades, and cross-sections indicated on the Drawings and compacted to the degree specified on the Drawings. Place bedding and backfill materials in horizontal lifts not to exceed 6 inches in thickness measured before compaction. The difference in level on either side of a pipe shall not exceed 4 inches.
 2. Backfill material shall not be placed over the pipe or conduit until the joints have been completed and inspected by the Construction Manager.

3. It shall be incumbent upon the Contractor to protect the pipe or conduit from damage during the construction period. It shall be his responsibility to repair broken or damaged pipe or conduit at no extra cost to the County. Carefully place backfill around and over the pipe or conduit. Tamping of backfill over the pipe shall be done with tampers, vibratory rollers and other machines that will not injure or disturb the pipe.
4. Do not allow construction traffic nor highway traffic over the pipe trench until the trench backfill has been brought back even with existing adjacent grade.

3.12 BACKFILL UNDER / ADJACENT TO STRUCTURES

- A. Compact materials in accordance with Paragraph 3.13 unless otherwise specified or shown on the Drawings.
- B. Place 3B Fine Gravel in uniform, level layers, not exceeding 6 inches thick measured before compaction under manhole structures, electrical vaults, building pad, and equipment pads.
- C. Rock subgrade under structures: Unless otherwise shown in the Drawings, place uniform bedding layer, consisting of 6 inches of No. 3B Fine Gravel (ASTM C33, No. 67 gradation), under structures placed over rock. Unless shown specifically otherwise in the Drawings, do not use rock as backfill above the elevation of the highest base slab of the structure.
- D. **BACKFILL ADJACENT TO STRUCTURES:**
 1. Backfill shall be native or imported backfill compacted in accordance with the requirements of Section 3.13 unless otherwise specified or shown on the Drawings.
 2. Do not place backfill against structures until the concrete has been patched and cured.
 3. Do not place backfill against structures until at least 28 days after the concrete was placed, or until the concrete has achieved a strength of at least 4,000 psi, whichever is earlier. Concrete strength shall be demonstrated by field cured cylinders tested at the Contractor's cost, prepared and tested in accordance with ASTM C31 and ASTM C39.
 4. Do not place backfill against hydraulic structures until the structure has passed the specified leakage tests.
 5. Place structural backfill in uniform, level layers, not exceeding 8 inches thick measured before compaction. Bring backfill up uniformly on all sides of the structure, and on both sides of buried walls.

E. BACKFILL FOR WALLS BELOW GRADE:

1. Backfill shall be placed in horizontal lifts not exceeding 8 inches in loose thickness. Only light, hand-operated compaction equipment (e.g., jumping jack, walk-behind vibratory plate compactor) shall be used within 10 feet of walls below grade.

3.13 COMPACTION

- A. Add water to the backfill material or dry the material as necessary to obtain moisture content within 2 percent of optimum. Employ such means as may be necessary to secure a uniform moisture content throughout the material of each layer being compacted.
- B. After the material has been moisture conditioned, compact it with compaction equipment appropriate for the use to achieve specified compaction.
- C. If the backfill material becomes saturated because it was not compacted to the specified density or was not backfilled and compacted to surface grade, through negligence or otherwise, remove the faulty material and replace it with suitable material compacted to the specified density. No additional payment will be made for doing such work or removal and replacement.
- D. Compact materials in accordance with ASTM D1557 (Modified Proctor) unless otherwise specified.
- E. Compaction of embankment and backfill materials by flooding, ponding, or jetting is not permitted.
- F. When densities of compacted materials do not meet the requirements, remove and/or recompact the material until the requirements are met. The Contractor will be back charged the cost of retesting all failing tests, including the initial retest. Such back charges will be deducted from the Contractor's Progress Payments.

G. MATERIAL REQUIREMENTS:

	Material	Minimum Relative Compaction¹
1.	Imported or Onsite Fill	95 percent
2.	Pipe Zone Backfill	95 percent
3.	Trench Zone Backfill	90 percent
4.	Pipe Bedding	90 percent
6.	Crushed Rock	95 percent
7.	Subgrade	95 percent in paved areas 90 percent in unpaved areas

	Material	Minimum Relative Compaction¹
8.	Aggregate Base	Refer to Section 02700.
9.	Structural Backfill	95 percent

¹Modified Proctor Test

3.14 SITE GRADING

- A. Tolerances: Grade the site to the elevations shown on the Drawings within the tolerances provided here:
- B. Excavation: Plus or minus $\frac{1}{2}$ inch.
- C. Backfill: Where backfilling due to excavation or temporary cut and fill operations, place lifts as specified herein with the following tolerance: Plus or minus 1 inch.
- D. Subgrade: Plus or minus $\frac{1}{2}$ inch.
- E. Fine grading (finished surface):
 - 1. Sidewalks: $\frac{1}{4}$ inch when tested with a 10-foot straight edge.
 - 2. Asphalt pavement: $\frac{1}{4}$ inch when tested with a 10-foot straight edge.
 - 3. Concrete pavement: $\frac{1}{4}$ inch when tested with a 10-foot straight edge.
 - 4. Landscaped areas: Plus or minus $\frac{1}{2}$ inch.
- F. Ditches and Swales: Cut ditches accurately to the cross sections and grades shown. Trim all roots, stumps, rock, and other foreign matter from the sides and bottom of the ditches.
- G. Gravel Areas: Place gravel material onsite to finished grade elevations as shown on the Drawings, unless otherwise noted.
- H. Landscaped Areas: Use Landscape Fill in the top 2 feet of areas to be landscaped.
- I. Where filter fabric is installed within an earthen or rock-lined drainage swale or channel, overlap filter fabric a minimum 12 inches with upstream fabric placed over downstream fabric. Join seams per manufacturer recommendations.
- J. Uniformly grade and provide drainage away from areas to collection points. Grade surfaces to drain away from structures at a minimum of 2 percent, unless otherwise noted on the Drawings.

END OF SECTION

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SECTION 02513

POLYVINYL CHLORIDE – PRESSURE SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes: Poly Vinyl Chloride (PVC) pressure piping sizes 4 inches to 60 inches in diameter. Provide all piping, fittings, and accessories as shown on the Drawings, as specified herein, and as required to completely interconnect all piping and equipment for a complete and operable system.

1.02 REFERENCES

- A. ASTM International (ASTM):
1. ASTM D1784 Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
 2. ASTM D2241 Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
 3. ASTM D2774 Standard Practice for Underground Installation of Thermoplastic Pressure Piping
 4. ASTM D3139 Standard Specification for Joints for Plastic Pressure Pipes
 5. ASTM F477 Using Flexible Elastomeric Seals for Standard Specification for Elastomeric Seals (Gaskets) Joining Plastic Pipe
- B. Uni-Bell PVC Pipe Association:
1. UNI-B-8 Recommended Practice for the Direct Tapping of Polyvinyl Chloride (PVC) Pressure Water Pipe
 2. UNI-PUB-9 Installation Guide for Gasketed-Joint PVC Pressure Pipe
 3. UNI-V-1 Tapping PVC Pressure Pipe
- C. American Water Works Association (AWWA):
1. AWWA C605 Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings
 2. AWWA C651 Disinfecting Water Mains

3. AWWA C900 Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 in. through 60 in. (100 mm through 1500 mm),
4. AWWA C907 for Water Transmission and Distribution Injection-Molded Polyvinyl Chloride (PVC) Pressure Fittings, 4 in. through 12 in. (100 mm through 300 mm),
- for Water, Wastewater, and Reclaimed Water Service
5. AWWA M23 PVC Pipe – Design and Installation

1.03 SUBMITTALS

- A. Submit in accordance with Section 01300.
- B. Shop Drawings:
 1. Pipe Layouts:
 - a. Shop drawings indicating layout of piping, fittings, valves, and other appurtenances necessary for a completed pipeline.
 2. Calculations: Calculations showing compliance under this section.
- C. Product Data:
 1. Submit data on the following items showing compliance under this section:
 - a. Pipe, fittings, and accessories
 - b. Gaskets
 - c. Connections to existing pipelines, laterals, and structures
 - d. Flexible couplings and flanged coupling adapters
 - e. Restrained joints
 - f. Water meters
 2. Manuals:
 - a. The Contractor shall furnish manufacturer's installation and operation manuals, bulletins, and spare parts lists for the following items:
 - 1) Water meters
 3. Certifications:
 - a. Certified affidavit of compliance with AWWA C900.
 - b. Certified field test reports specified herein.

1.04 QUALITY ASSURANCE

- A. The Pipe Manufacturer shall be a member of the Uni-Bell PVC Pipe Association.

PART 2 - PRODUCTS

2.01 PVC PIPE

- A. Sizes: 1 to 4 inches in diameter. Unless stated otherwise,
 - 1. PVC pipes shall be manufactured and supplied in accordance with AWWA C900.
- B. Minimum Working Pressure:
 - 1. Pressure Class 150 psi / Dimension Ratio 18
 - 2. Provide wall thicknesses per these pressure classes.
- C. The pipe shall be made of PVC compound having a cell classification of 12454 or 12364 in accordance with ASTM D1784.
- D. Pipe shall be homogenous throughout, free of voids, cracks, inclusions, and other defects.
- E. Pipe for potable water use shall be blue or white in color. Pipe for recycled or reclaimed water (including irrigation) use shall be purple in color. Pipe for other non-potable water uses shall be green or white in color.
- F. Pipe outside diameters shall be equal to those of cast iron (cast iron pipe sizes, CIPS) unless otherwise specified by the Owner.
- G. Pipe Identification:
 - 1. Buried pipe markings shall conform to AWWA C900:
 - a. Pipe shall have markings at the ends of each pipe stick
 - 1) Manufacturer's name or trademark and lot code
 - 2) Nominal pipe size and OD (e.g., CIOD or IPS)
 - 3) Legend (e.g., PVC AWWA C900)
 - 4) Dimension ratio
 - 5) Pressure class in psi
 - 6) Hydrostatic integrity test pressure
 - 7) Mark of certifying agency (for potable water service) or "NOT FOR POTABLE USE" (for non-potable water service)
 - 2. Exposed piping: Refer to Section 15050.
- H. Acceptable Pipe Manufacturers:
 - 1. Charlotte Pipe and Foundry Company
 - 2. Diamond Plastics Corps.
 - 3. Westlake Chemical Corporation
 - 4. or equal

2.02 FITTINGS

- A. Fittings shall be PVC manufactured and supplied in accordance with AWWA C900.
 - 1. Fittings shall be made of PVC compound having a cell classification of 12454 or 13343 in accordance with ASTM D1784.

2. Pipe used in fabricated fittings shall have a wall thickness equal to or greater than the wall thickness of the pipes to which the fitting will be joined.
 3. Acceptable PVC fitting manufacturers shall be the same as identified for pipes.
- B. Fitting Identification:
1. Each fitting shall be clearly labeled. Identify:
 - a. Size
 - b. Pressure class
 - c. Angle deflection, if applicable

2.03 JOINTS

- A. Less than 4 inch pipes shall be solvent weld, except flanged or threaded permitted where required at equipment connections and where required on the Drawings.
- B. 4 inch and larger pipe joints shall be gasket, bell and spigot and push-on type conforming to ASTM D3139.
 1. The bell and coupling shall be the same, or greater, thickness as the pipe barrel.
 2. Deflection at the joint shall not exceed 1 degree or the maximum deflection recommended by the manufacturer, whichever is smaller.
 3. Gaskets: Gasket material shall be SBR or NBR (Nitrile or Buna-N) or EPDM in accordance with ASTM F477.
 4. If gaskets are supplied separately from pipe, it is the Contractor's responsibility to ensure that the gaskets supplied are designed for the pipe in use.
 5. Joint lubricant shall be approved by the pipe manufacturer and shall have no detrimental effect on the gasket or pipe.

2.04 JOINT RESTRAINT

- A. Push-on Joint Restraint:
 1. Pressure Ratings shall be 350 psi for 4" through 24", and 250 psi for 30" through 64"
 2. Restraints for AWWA C900 push-on pipe joints:
 - a. EBAA Iron 1900 Series (4"-12")
 - b. EBAA Iron Megalug 2800 Series (14"-54")
 - c. Or equal
 3. Restraints for AWWA C900 push-on pipe at PVC fittings:
 - a. EBAA Iron 2500 Series (4"-48")
 - b. Or equal
 4. Gasket system shall conform to AWWA C11
 5. Gripping-type gaskets shall not be used.

2.05 SERVICE CONNECTIONS

- A. General: All corporation stops, service clamps or saddles, and service connection accessories shall be the product of one (1) manufacturer.
- B. Service Clamps:
 - 1. Type: Bronze, double-strap, retained O-ring gasket, rolled strap threads, and tapping boss with full length threads.
 - 2. Manufacturer: Mueller Co.; Clow; or equal.
- C. Corporation Stops:
 - 1. Rating: 100 psi water
 - 2. Type: Thread inlet; compression connection outlet
 - 3. Manufacturer: Mueller Co.; Ford; or equal.
- D. Curb Stops:
 - 1. Rating: 100 psi water
 - 2. Type: Copper service thread both ends
 - 3. Manufacturer: Mueller Co.; Ford; or equal.
- E. Water Meters:
 - 1. Type: Turbine meter with sealed magnetic drive and sealed totalizer. Provide totalizer extensions where shown on the Drawings.
 - 2. Rating: 150 psi
 - 3. Materials:
 - a. Meter tube: Fabricated steel with fusion epoxy lining and coating
 - b. Magnets: Ceramic
 - c. Bearings: Stainless steel or ceramic
 - 4. Units of measurement: Gallons
 - 5. Manufacturer: Water Specialties; Rockwell; or equal.
- F. Meter Boxes:
 - 1. Type: Plastic structural foam box with plastic locking cover having a hinged plastic reader lid and a metal base plate.
 - 2. Manufacturer: Mueller Co.; Clow; or equal.

2.06 CONNECTIONS TO EXISTING PIPELINES

- A. Direct tapping is not permitted.
- B. Saddle Tapping:
 - 1. Saddle tapping shall be used for service connections up to 2 inches in diameter. Service saddles shall:
 - a. Be designed and sized for piping material to be used with
 - b. Provides full support around the circumference of the pipe
 - c. Be double strap bronze service clamps
 - d. Have threads that match the threads of the corporation stop being used
 - 2. Acceptable Manufacturers:
 - a. Smith-Blair; equivalent by Mueller; or equal.

3. Saddles shall be in accordance with Section 15050.
- C. Sleeve Tapping:
1. Sleeve tapping shall be used for taps larger than 2 inches in diameter.
Tapping sleeves shall:
 - a. Provide full support around the circumference of the pipe
 - b. Prevent sufficient length to seal and prevent movement
 2. Tapping sleeves shall be installed with tapping valves. Refer to Section 15050.
 - a. Acceptable Manufacturers:
 - 1) Smith-Blair; equivalent by Mueller; or equal.
 - b. Sleeves shall be in accordance with Section 15050.

PART 3 - EXECUTION

3.01 BURIED PIPE AND FITTINGS INSTALLATION

- A. Field cutting: Cut pipe ends square and bevel with a beveling tool, wood rasp, or power sander to the same angle and length provided on the factory-finished pipe. Redraw the insertion line on the spigot using a factory-marked spigot as a guide.
- B. Install pipe, fittings, specials, and appurtenances in accordance with AWWAC605, AWWA M23, UNI-B-9, and the Pipe Manufacturer's recommendations.
- C. Install Joint Assembly:
 1. Install push-on joints in accordance with AWWA C900.
 2. Pipes 4 inches to 12 inches: Bar-and-block method or other method approved for use by the Owner and Pipe Manufacturer.
 3. Pipes 15 inches to 60 inches: Mechanical assistance such as hydraulic pipe pullers, or pulleys, may be used. Provide a spotter to observe joint assembly to prevent over-insertion.
- D. Tap pipe in accordance with AWWA C605, AWWA M23, UNI-B-8, and the Pipe Manufacturer's recommendations.

3.02 CONNECTIONS TO EXISTING PIPELINES

- A. Direct tapping is not permitted.
- B. Tapping Saddles:
 1. Single fluted shell cutters or twist drills are not acceptable.
 2. Lubricate the cutting and tapping edges of the tool with cutting lubricant. Make the cuts slowly and use the follower very lightly - do not force cutter through pipe wall. Shell cutter shall have sufficient throat depth to handle the heavy wall PVC pipe.
 3. Use an internal shell cutter to drill through the corporation stop to minimize PVC shavings, retain the coupon, and reduce stress.

C. Tapping Sleeves: Assemble and install in accordance with the Manufacturer's recommendations.

3.03 FLUSHING

A. Refer to Section 15050 for flushing requirements.

3.04 PRESSURE TESTING

A. Refer to Section 15050 for hydrostatic testing requirements.

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SECTION 02514

POLYVINYL CHLORIDE PIPE – GRAVITY SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes: Poly Vinyl Chloride (PVC) gravity piping sizes 4 inches to 60 inches in diameter. Provide all piping, fittings, and accessories as shown on the Drawings, as specified herein and as required to completely interconnect all piping and equipment for a complete and operable system.

1.02 REFERENCES

- A. ASTM International (ASTM):
1. ASTM D3034 Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
 2. ASTM D2321 Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
 3. ASTM D1784 Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
 4. ASTM D3212 Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
 5. ASTM F477 Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
 6. ASTM F679 Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
 7. ASTM F1336 Standard Specification for Poly(Vinyl Chloride) (PVC) Gasketed Sewer Fittings
 8. ASTM F1417 Standard Practice for Installation Acceptance of Plastic Non-Pressure Sewer Lines Using Low-Pressure Air
- B. Uni-Bell PVC Pipe Association:
1. UNI-B-6 Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe
 2. UNI-PUB-6 Installation Guide for Solid-Wall PVC Sewer Pipe (4-48 in.)

- C. American Water Works Association (AWWA):
 - 1. AWWA M23 PVC Pipe – Design and Installation

1.03 SUBMITTALS

- A. Submit in accordance with Section 01300.
- B. Product Data:
 - 1. Submit data on the following items showing compliance under this section:
 - a. Pipe, fittings, and accessories
 - b. Gaskets
 - c. Connections to existing pipelines, laterals, and structures
 - d. Flexible couplings and flanged coupling adapters
 - e. Cleanouts
 - 2. Certifications:
 - a. Certified affidavit of compliance with reference specifications specified herein.
 - b. Certified field test reports specified herein.

1.04 DELIVERY, HANDLING, AND STORAGE

- A. Cover pipe from direct sunlight and protect from heat sources, such as heaters, boilers, steam lines and engine exhaust, to protect pipe and coatings.
- B. Protect gaskets from direct sunlight and head sources.

1.05 QUALITY ASSURANCE

- A. The Pipe Manufacturer shall be a member of the Uni-Bell PVC Pipe Association.

PART 2 - PRODUCTS

2.01 PVC PIPE

- A. Sizes: 4 to 30 inches in diameter. Unless stated otherwise,
 - 1. Pipes 4 inches through 15 inches shall be SDR 35 per ASTM D3034
 - 2. Pipes 18 inches through 60 inches shall have a pipe stiffness (PS) of 46 psi per ASTM F679
- B. Lay length: Pipe furnished shall have normal laying length of 18 feet to 22 feet.
- C. The pipe shall be made of PVC compound having a cell classification of 12454 or 12364 in accordance with ASTM D1784.
- D. Pipe shall be homogenous throughout, free of voids, cracks, inclusions, and other defects.

- E. Gasketed pipe shall be marked with an insertion depth mark on the spigot end.
- F. Pipe for non-potable water and wastewater uses shall be green or white in color.
- G. Pipe outside diameters shall be equal to those of cast iron unless otherwise specified.
- H. External Coating: Not Used.
- I. Internal Lining: Not Used.
- J. Pipe and Fitting Identification:
 - 1. Buried piping: Pipe markings shall conform to ASTM D3034.
 - a. Pipe shall have markings at the ends of each pipe:
 - 1) Manufacturer's name or trademark and code
 - 2) Nominal pipe size
 - 3) Legend (e.g., "SDR-35 PVC Sewer Pipe" or "PS 46 PVC Sewer Pipe")
 - 4) ASTM Designation
 - b. Molded and fabricated fittings shall have markings including:
 - 1) Manufacturer's name or trademark
 - 2) Nominal size
 - 3) Material designation (e.g., "PVC")
 - 4) ASTM Designation
 - 2. Exposed piping: Refer to Section 15050.
- K. Acceptable Pipe Manufacturers:
 - 1. Charlotte Pipe and Foundry Company
 - 2. Diamond Plastics Corps.
 - 3. Westlake Chemical Corporation
 - 4. or equal

2.02 FITTINGS

- A. Fittings may be molded, or fabricated fittings manufactured in accordance with:
 - 1. Fittings 4 inches through 15 inches shall be SDR 35 per ASTM D3034
 - 2. Fittings 18 inches through 60 inches shall have a pipe stiffness (PS) of 46 psi per ASTM F679
- B. Fittings shall be made of PVC compound having a cell classification of 12454 or 13343 in accordance with ASTM D1784.
- C. Pipe used in fabricated fittings shall have a wall thickness equal to or greater than the wall thickness of the pipes to which the fitting will be joined.
- D. Fittings may also be supplied as ductile iron fittings in accordance with AWWA C110 and/or C153. Ductile iron pipe fittings shall be in accordance with Section 15050.

E. Acceptable PVC fitting manufacturers shall be the same as identified for pipes.

2.03 JOINTS

- A. Joints: Joints shall be gasketed push-on type conforming to ASTM D3212.
- B. Gaskets: Gasket material shall be SBR or NBR (Nitril or Buna-N) in accordance with ASTM F477.
 - 1. If gaskets are supplied separately from pipe, it is the Contractor's responsibility to ensure that gaskets supplied are designed for the pipe in use.
- C. Joint lubricant shall be approved by the Pipe Manufacturer and shall have no detrimental effect on the gasket or pipe.

2.04 CLEANOUTS

- A. Provide new cleanouts on each building sewer behind the curbs near the property line as shown on the Drawings.
- B. Size of cleanouts shall match the diameter of the pipe.

2.05 CONNECTIONS TO EXISTING PIPELINES

- A. Compression fit three-piece lateral connection consisting of a PVC hub, rubber sleeve, and stainless-steel band compatible with SDR 35 PVC or PS 46 pipe (as applicable) and existing pipeline.
 - 1. Acceptable Manufacturers:
 - a. Inserta-Tee; or equal.
- B. Connections to existing laterals shall be made with rubber couplings and elastomeric bushings sealed with stainless steel bands or Calder couplings.
 - 1. Acceptable Manufacturers:
 - a. Joints Couplings; Fernco; or equal

2.06 CONNECTIONS TO GRAVITY STRUCTURES (E.G., MANHOLES, CATCH BASINS)

- A. At connections to structures, use a water-stop gasket produced from elastomeric material.
- B. Use non-shrinking or expansive type grout.
- C. Manhole Adaptors: Manhole adaptors shall be SBR rubber manhole waterstops for use with PVC sewer pipe in accordance with ASTM C923 OR HDPE Flexible Connector Boot.
 - 1. Acceptable Manufacturers:
 - a. Fernco; or equal
 - b. Kor-N-Seal; or equal

- D. Transition Donuts: Transition donuts shall be elastomeric plastic resistant to sewage and grease, chemicals, and normal sewer gases. They shall be designed to be inserted in the bells of sewer pipe to adapt the bell to accept the spigot of a smaller size spigot. They shall have reversed fins on the inside and outside to grip the bell and spigot. Transition donuts cast or grouted into concrete pipe or manhole sections shall have an outside diameter at least 2 inches greater than the inside diameter.
1. Acceptable Manufacturers:
 - a. Fernco; Indiana Seal; or equal

PART 3 - EXECUTION

3.01 BURIED PIPE AND FITTINGS INSTALLATION

- A. Install pipe, fittings, specials, and appurtenances in accordance with ASTM D2321, UNI-PUB-6, and the Pipe Manufacturer's recommendations.
- B. Joint Assembly:
 1. Pipes 4 inches to 12 inches: bar-and-block method or other method approved for use by the Owner and Pipe Manufacturer.
 2. Pipes 15 inches to 60 inches: mechanical assistance such as hydraulic pipe pullers, or pulleys, may be used. Provide a spotter to observe joint assembly to prevent over-insertion.

3.02 LEAK TESTING

- A. Leak testing shall be completed in accordance with ASTM F1417 "Standard Practice for Installation Acceptance of Plastic Non-Pressure Sewer Lines Using Low-Pressure Air" and UNI-B-6 "Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe."

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SECTION 02700

PAVING AND SURFACING

PART 1 - GENERAL

1.01 SUMMARY

- A. Furnishing all labor, material, equipment, tools, and services required to install and restore asphalt concrete pavement as indicated on the Drawings and specified herein.
- B. This work includes the paving of the areas within the Napili WWPS No. 2 fence line and any miscellaneous disturbed areas due to Contractor operations as determined to restore at the direction of the Construction Manager.

1.02 REFERENCES

- A. Whenever the words "Standard Specifications" are referred to, the reference is to the Standard Specifications for Public Works Construction, Department of Public Works, County of Maui, September 1986, including all amendments and additions.

1.03 SUBMITTALS

- A. Submit in accordance with Section 01300.
- B. Samples: Furnish, without additional cost to the County, such quantities of construction materials as may be required by the Construction Manager for test purposes. The Contractor shall cooperate with the Construction Manager and furnish necessary facilities for sampling and testing of all materials and workmanship. All materials furnished and all work performed shall be subject to rigid inspection, and no materials shall be used in the construction work until it has been inspected by the Construction Manager.
- C. Test Reports: The Contractor shall furnish to the Construction Manager test reports including trial batch reports, asphalt concrete, density, thickness, and mix design for asphalt concrete.
- D. Certificates: The Contractor shall furnish to the Construction Manager certificates including the asphalt mix delivery record, asphalt concrete and material sources, and certification such that the materials and incidental construction items furnished under this section conform to the requirements of this specification.

1.04 QUALITY ASSURANCE

- A. Comply with the provisions of the Standard Specifications.

- B. All pavement stripe painting shall be performed by competent and experienced Equipment operators and painters using proper equipment, tools, stencils, templates, and shields in a workmanlike manner.

1.05 REGULATORY REQUIREMENTS

- A. Place bituminous mixture only during dry weather and on dry surface.

PART 2 - PRODUCTS

2.01 SYSTEM DESCRIPTION

- A. Perform the work consisting of pavement courses composed of mineral aggregate and asphalt material heated and mixed in a central mixing plant and placed on a prepared course. HMA designed and constructed in accordance with this section shall conform to the lines, grades, thicknesses, and typical cross sections indicated. Construct each course to the depth, section, or elevation required by the drawings and roll, finish, and approve it before the placement of the next course.
- B. Asphalt Mixing Plant: Plant used for the preparation of hot-mix asphalt shall conform requirements of AASHTO M 156.
- C. Hauling Equipment: Provide trucks for hauling hot-mix asphalt having tight, clean, and smooth metal beds. To prevent the mixture from adhering to them, the truck beds shall be lightly coated with a minimum amount of paraffin oil, lime solution, or other approved material. Petroleum based products shall not be used as a release agent. Each truck shall have a suitable cover to protect the mixture from adverse weather. When necessary to ensure that the mixture will be delivered to the site at the specified temperature, truck beds shall be insulated or heated and covers (tarps) shall be securely fastened.
- D. Asphalt Pavers: Provide asphalt pavers which are self-propelled, with an activated screed, heated as necessary, and capable of spreading and finishing courses of hot-mix asphalt which will meet the specified thickness, smoothness, and grade. The paver shall have sufficient power to propel itself and the hauling equipment without adversely affecting the finished surface.
1. Receiving Hopper: Provide paver with a receiving hopper of sufficient capacity to permit a uniform spreading operation and equipped with a distribution system to place the mixture uniformly in front of the screed without segregation. The screed shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture.
- E. Rollers: Rollers shall be in good condition and shall be operated at slow speeds to avoid displacement of the asphalt mixture. The number, type, and

weight of rollers shall be sufficient to compact the mixture to the required density while it is still in a workable condition. Do not use equipment which causes excessive crushing of the aggregate.

2.02 TACK COAT

- A. Material for tack coat shall be SS-1 or SS-1h grade emulsified asphalt conforming to Standard Specifications Section 33, Asphalt Surface Treatment.

2.03 PRIME COAT (PENETRATION TREATMENT)

- A. Material for tack coat shall be SS-1 or SS-1h grade emulsified asphalt conforming to Standard Specifications Section 33, Asphalt Surface Treatment.

2.04 AGGREGATE BASE

- A. Aggregate and aggregate gradation shall be in accordance Standard Specifications Section 31, Aggregate Base Course. And the maximum size of the aggregate shall be 1-1/2-inch.
- B. Mineral filler shall be non-plastic mineral meeting the requirements of ASTM D242.

2.05 ASPHALT TREATED BASE

- A. Provide in accordance with Standard Specifications Section 32.2.

2.06 ASPHALT CEMENT BINDER

- A. Asphalt cement binder shall conform to AASHTO M 320 Performance Grade (PG) 64-16 Test data indicating grade certification shall be provided by the supplier at the time of delivery of each load to the mix plant. Copies of these certifications shall be submitted to the Construction Manager. The supplier is defined as the last source of any modification to the binder. The Construction Manager may sample and test the binder at the mix plant at any time before or during mix production. Samples for this verification testing shall be obtained by the Contractor in accordance with ASTM D140 and in the presence of the Construction Manager. These samples shall be furnished to the Construction Manager for the verification testing, which shall be at no cost to the Contractor. Samples of the asphalt cement specified shall be submitted for approval not less than 14 days before start of the test section.

2.07 MIX DESIGN

- A. All asphalt concrete pavement shall be State of Hawaii Mix IV unless alternative mix is approved by the Construction Manager.

2.08 TRAFFIC STRIPES AND PAVEMENT MARKINGS

- A. Pavement markings shall comply with HI DOT Section 629, Pavement Markings.

2.09 LIQUID ASPHALT DISTRIBUTOR

- A. The distributor used in applying all liquid asphalt shall be of the self-propelling type, of sufficient power and capacity to apply the asphalt under pressure uniformly and at the proper rate with not more than 10 percent variation therefrom. The distributor shall be equipped with tachometer and charts, pressure gauge, thermometer well, and thermometer; and shall have adjustable length spray bars of sufficient length to cover one-half of the roadbed at one time. The spray bars shall be adjustable vertically to permit application of the asphalt at the height above the surface approved by the Construction Manager and shall be of the full-circulating type with satisfactory cutoff device at each nozzle. The use of trailer-type distributors shall not be permitted.
- B. A trough shall be located under the sprays, properly arranged to be swung out of the way after the sprays are operating in a uniform manner at the desired pressure or, in lieu thereof, building paper shall be spread over the treated surface for a sufficient length back so that the sprays are operating properly when the uncovered surface is reached. The building paper shall then be removed and disposed of. If the cutoff is not sufficiently positive, the similar use of paper may be required at the end of the area being covered. The distributor shall be operated in such a manner that liquid asphalt will not be splashed on adjacent guardrails or structures. Any asphalt so splashed may be removed at the expense of and by the Contractor.

PART 3 - EXECUTION

3.01 GENERAL

- A. This Specification shall cover newly paved areas as well as existing pavement restoration.
- B. Where trenching or other construction activity has resulted in damage to a localized area of pavement, the damaged pavement shall be cut back 6 inches and shall be removed and replaced.
- C. Where the damaged area extends over more than 50 percent of the road width or paved area, as determined by the Construction Manager, the full pavement width or area shall be cut away, removed and repaired.
- D. Structures such as valve boxes, manhole frames and covers, and electrical vaults shall be adjusted to grade as necessary within paved areas.
- E. Adjust existing manholes, meter boxes, cleanouts, etc. to match the new grade.

3.02 PAVEMENT CUTTING

- A. After backfilling and prior to paving, proper tools and equipment shall be used in marking and breaking so that the pavement shall be cut accurately and on neat lines parallel to the trench. The asphalt pavement shall be saw cut (using a concrete saw) to a minimum depth equal to or greater than one-half the thickness thereof. The pavement shall be cut back 6 inches on each side of the trench or excavation wall. Any pavement damaged outside these lines shall be re-cut and restored at the expense of the Contractor. Should voids develop under existing pavements during construction, those affected pavements shall be neatly saw cut in straight lines and replaced after the voids have been filled.
- B. Construct joints between successive runs vertical and at right angles to the line of the improvement. Exercise care in construction of all joints to ensure that the surface of the pavement is true to grade and cross-section. Lapped joints will not be permitted.

3.03 PLACEMENT OF AGGREGATE BASE

- A. Subgrade Preparation: The subgrade shall be watered or dried as required to bring the soil, as close as practicable, to the optimum moisture content for proper compacting and then compacted, as specified, to a relative compaction of not less than 95 percent in the upper 6 inches. When compaction of the subgrade areas on fill and embankments has been properly obtained, only such additional rolling will be required as necessary to obtain a thoroughly compacted subgrade immediately prior to placing the aggregate base thereon.
- B. Aggregate Base Tolerance: The aggregate base shall not be placed before the subgrade is approved by the Construction Manager. The finished aggregate base shall not vary more than 0.05-foot above, nor 0.10-foot below, the planned grade.
- C. Aggregate Base Placing: The aggregate base material shall be spread on the prepared subgrade by means of approved spreading devices subject to approval by the Construction Manager; the aggregate base material may be dumped in piles upon the subgrade and spread by bulldozing ahead from the dumped material. Each layer shall not exceed 0.50 feet. Segregation of large or fine particles of aggregate shall be avoided, and the material as spread shall be free from pockets of large and fine material.
- D. Compaction: The relative compaction of each layer of compacted aggregate base material shall not be less than 95 percent as determined by ASTM D 1557, Methods of Test for Moisture - Density Relation of Soils, Using 10-Lb. Rammer and 18-Inch Drop – Method D. Compaction shall be in accordance with Section 31 of the Standard Specifications.

3.04 PRIME COAT APPLICATION

- A. **Prime Coat:** In advance of spreading paving materials, a prime coat of liquid asphalt shall be applied to all base course surface areas to be covered with asphaltic concrete.
1. Preparation of Base Course: Immediately before applying the prime coat, the area to be surfaced shall be cleaned of all loose material by means of hand brooms.
 2. Application: Liquid asphalt shall be applied by pressure distributors at a temperature between 125 and 200°F. The Construction Manager reserves the right to require an adjustment of the temperature of the liquid asphalt at the time of placement. The rate of application shall be between 2/10 and 3/10 gallon per square yard. Excess liquid asphalt, which has failed to penetrate the base, shall be covered with fine sand. All loose sand shall be removed from the treated areas before placing any surfacing material thereon. Liquid asphalt shall not be applied when the atmospheric temperature is below 50°F. The prime coat shall be applied at least 24 hours in advance of paving. Immediately in advance of paving asphalt concrete surfacing, additional prime coats shall be applied, as directed by the Construction Manager, to areas where the prime coat has been damaged.

3.05 TACK COAT APPLICATION

- A. **Tack Coat:** In advance of spreading bituminous material upon an existing bituminous surface, a tack coat shall be applied to all areas to be surfaced and to all vertical surfaces of existing pavement, curb, gutters and construction joints in the surfacing against which additional material is to be placed. When two or more lifts of asphaltic concrete are required, a tack coat shall be applied between each lift.
1. Preparation: Immediately before applying a tack coat, the area to be surfaced shall be cleaned of all loose material.
 2. Application: The tack coat shall be applied by means of pressure distributors by pressure hand-spray equipment. The rate of application shall be 1/20 gallon per square yard. Emulsified asphalt shall not be applied when the atmospheric temperature is below 40°F. If emulsified asphalt Type SS-1 is used, it may be diluted with an equal part of water. The rate of application of the dilution shall be such that the rate of application of undiluted emulsion shall be within the tolerances specified.

3.06 PLACEMENT OF ASPHALT TREATED BASE

- A. Place in accordance with Standard Specification Section 32.2.

3.07 PLACEMENT OF ASPHALT CONCRETE

- A. **Delivery and Spreading:** Bituminous mixtures shall be delivered to the roadbed at temperatures specified in the Standard Specifications Section 34, Asphalt Concrete. Spreading of the mixture shall be in accordance with Standard Specifications. All loads shall be covered with tarpaulin or other material during transportation. The maximum depth of asphalt concrete which may be spread and rolled in any one course or lift shall not exceed a compacted thickness of 2-1/2 inches. The minimum thickness of each lift shall not exceed 1-inch. Longitudinal joints in any two successive lifts or courses shall be offset at a minimum of 6 inches so that no joint shall be directly over another.
- B. **Compaction:** Initial or breakdown rolling and the final rolling of the uppermost layer of the asphalt concrete shall be compacted in accordance with Standard Specification Section 34, Asphalt Concrete. Compaction by vehicular traffic shall not be permitted. The Construction Manager reserves the right to require an adjustment of the temperature of the asphalt concrete at the time of placement.
- C. **Pavement Thickness:** Pavement shall match the existing adjoining pavement in thickness, or as indicated on the Drawings, or as specified, whichever is greater.
- D. **Smoothness:** The finished surface of the pavement shall be true to grade and cross section, free from depressions and grain spots, and of uniform texture. It shall not vary more than 1/8 of an inch from any point along the bottom of a 10-foot straightedge laid in any direction except across the crown.
- E. **Joining Pavement:** The joints between old and new pavements or between successive days' work shall be carefully made in such manner as to ensure a continuous bond between old and new sections of the course. Edges of existing pavement shall be exposed and cleaned and edges cut to straight, vertical surfaces. All joints shall be painted with a uniform coat of tack coat before the fresh mixture is applied.
- F. **Protection of Pavement:** After final rolling, no vehicular traffic of any kind shall be permitted on the pavement until it has cooled and hardened and in no case less than 6 hours.

3.08 PAVEMENT RESTORATION

- A. Final pavement restoration shall be made as soon as practicable after backfilling. In that period of time between backfilling and final pavement restoration, the trench shall be maintained level with the adjacent pavement and shall be covered with a 1-inch minimum layer of cutback. Prior to placing the final pavement, the temporary pavement shall be removed, the aggregate base excavated to the lines indicated on the Drawings, and the existing pavement edges saw cut as herein specified. The final asphalt

pavement shall not be placed before the primed aggregate base surface is approved by the Construction Manager.

3.09 PROTECTION

- A. Do not permit vehicular traffic, including heavy equipment, on pavement until surface temperature has cooled to at least 120° F. Measure surface temperature by approved surface thermometers or other satisfactory methods.

3.10 FINAL INSPECTION

- A. At the time of final inspection of the work performed under the Contract, the work covered by this Section shall be complete in every respect and operating as designed. All surplus materials of every character, resulting from the work of this Section, shall have been removed. Any defects discovered in the work, subsequent to this inspection, shall be corrected prior to final acceptance.

END OF SECTION

SECTION 02820

FENCES AND GATES

PART 1 - GENERAL

1.01 SUMMARY

- A. All materials and work required for the furnishing and installation of:
 - 1. Chain link fence
 - 2. Gates
- REFERENCES**
- B. American Society for Testing and Materials (ASTM):
 - 1. A53 Specification for Pipe, Steel Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - 2. A121 Specification for Zinc-Coated (Galvanized) Steel Barbed Wire
 - 3. A392 Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric
 - 4. A702 Specification for Steel Fence Posts and Assemblies
 - 5. F934 Standard Specification for Standard Colors for Polymer-Coated Chain Link Fence Materials
 - 6. F1043 Standard Specification for Strength and Protective Coatings on Steel Industrial Fence Framework
 - 7. F1083 Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
 - 8. F1184 Standard Specification for Industrial and Commercial Horizontal Slide Gates
 - 9. F2200 Standard Specification for Automated Vehicular Gate Construction
- C. International Code Council (ICC):
 - 1. 2018 International Building Code (IBC) (Hawaii)
- D. Chain Link Fence Manufacturers Institute (CLFMI)
 - 1. Product Manual
 - 2. WLG 2445 Chain Link Fence Wind Load Guide For The Selection Of Line Post And Line Post Spacing
- E. National Fire Protection Association (NFPA)
- F. Underwriter Laboratories (UL)
 - 1. UL 325 Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems

1.02 DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS

- A. All work and materials shall conform to the requirements of referenced Standard Specifications, except as modified herein. In case of any conflict

between the Standard Specifications and the Contract Plans and Specifications, the latter shall control.

1.03 SUBMITTALS

- A. Product Data: Fully describe all products proposed for use.
 - 1. Fence and gate posts, rails, and fittings.
 - 2. Chain-link fabric, reinforcements, and attachments.
 - 3. Gates and hardware.
- B. Shop Drawings: Show the specific items and assemblies proposed for this project. Show locations of fences, gates, posts, rails, tension wires, details of extended posts, extension arms, gate swing, or other operation, hardware, and accessories. Indicate materials, dimensions, sizes, weights, and finishes of components. Include plans, gate elevations, sections, details of post anchorage, attachment, bracing, and other required installation and operational clearances.
- C. Manufacturer's standard and custom color chart selections showing full range of colors available for components with factory-applied color finishes.
- D. Operation and Maintenance Data:
 - 1. Polymer finishes.
 - 2. Gate hardware.

1.04 QUALITY ASSURANCE

- A. Contractor's Qualifications: An experienced installer who has designed and constructed chain-link fences and gates control systems similar in material, design, and extent to those indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Comply with requirements of local Fire Marshal Fire and Prevention Department having jurisdiction for emergency operation of gated entry points.
- C. Comply with applicable provisions in the IBC, adopted edition.
- D. All work shall be in strict conformance with manufacturer's printed instructions and recommendations.
- E. ENGINEERING RESPONSIBILITY: Preparation of data for chain-link fences and gates, gate control systems including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

1.05 STRUCTURAL PERFORMANCE

- A. Provide chain-link fences and gates capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. MINIMUM POST SIZE AND MAXIMUM SPACING FOR WIND VELOCITY PRESSURE: Determine based on mesh size and pattern

specified, and on the following minimum design wind pressures and according to CLFMI WLG 2445:

- a. Wind Speed: 115 mph.
- b. Fence Height: As shown on the Drawings.
- c. Line Post Group: IA, ASTM F1043, Schedule 40 steel pipe.
- d. Wind Exposure Category: B.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in good condition and properly protected against damage to factory-finished surfaces.
- B. Store materials in a clean, dry location. Cover with protective materials to avoid damage, especially from dust, chemicals, and moisture in the air.
- C. Handle materials carefully on the job site to protect factory finishes.

1.07 SPECIAL WARRANTY

- A. Provide manufacturer's standard limited warranty covering slide gate and truck assembly against failure resulting from normal use for a period of 5 years from date of purchase. Failure is defined as any defect in manufacturing that prevents the gate from operating in a normal manner.

PART 2 - PRODUCTS

2.01 CHAIN LINK FENCING

- A. General: Height indicated on Drawings. Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist. Comply with ASTM A392, CLFMI CLF 2445, and requirements indicated below:
 1. WIRE FABRIC: 9 GA aluminum chain link fabric with a diameter of 0.148 inches.
 2. MESH SIZE: 2 inches.
- B. SELVAGE:
 1. SECURITY FENCE: Knuckled top and knuckled bottom.
- C. Unless otherwise shown on the Drawings, the fence shall have top rail and bottom tension wire.
- D. Fence posts, braces and top rails shall be Schedule 40 galvanized steel pipe ASTM A53. Strength requirement to be heavy industrial according to ASTM F1043. Line posts shall be 2 3/8 inches in diameter. Corner and end posts shall be 3-1/2 inches in diameter. Personnel gate posts shall be a minimum of 2-7/8 inches in diameter. Rolling gate posts shall be a minimum of 4 inches in diameter. Fence braces and top rails shall be 1-5/8 inches in diameter. Posts shall have galvanized caps to exclude moisture. Truss rods shall be 3/8-inch diameter galvanized steel. Tension wires shall conform to the Standard Specifications.

E. Concrete foundations for fence posts shall be as detailed on the Drawings

2.02 STEEL GATE, SLIDING - ROLLING

- A. Provide a hand-operated steel sliding rolling gate. Builders Fence Company, Inc.; Amazing Gates; or equal.
1. All components shall be steel pipe, all joints shall be welded, and all members hot-dip galvanized after fabrication. Finish to match fence panels.
 2. Gate frame shall be constructed as shown in Drawings. Weld corners to create a rigid frame. Diagonal braces shall be installed such that the low end of the braces shall be toward the forward end of the gate as the gate rolls closed (i.e., low end of the braces toward the end of the gate that rolls on the ground and high end of the braces toward the end of the gate that is supported on the adjacent stationary fence).
 3. Gates shall be furnished complete with all necessary hardware, including hinges, latches and stops.
 4. Fabric to match adjacent fence panels.
 5. Gate hangars and support wheels:
 - a. Support the bottom edge of the gate at least 8 feet on center on 4-inch-diameter 1-1/2-inch-thick sealed ball bearing mounted, lath turned "V" grooved steel wheels that run on an inverted "V" steel track the full width of the opening. Support the top of the gate with a steel wheel running on sealed ball bearings and mounted on a vertical shaft attached to the trailing post and running inside of a "U" shaped 5/8-inch-thick stainless-steel track mounted on the side of the gate adjacent to the top horizontal rail. Provide barrier coating at dissimilar materials.
 6. Sliding gate top and bottom wheels and other hardware shall be by Richards Wilcox; Stanley; or equal.
 - a. Include eyes to permit locking gate with a padlock.
- B. Finish:
1. All steel material shall be hot-dip galvanized G-90.
 2. Rinse and clean.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions, with installer present, for compliance with requirements for site clearing, earthwork, pavement work, and other conditions affecting performance.
1. Do not begin installation before final grading is completed, unless otherwise permitted by the Owner.
 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.
- B. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.03 INSTALLATION OF CHAIN LINK FENCING

- A. Install chain link fencing and gates at the locations shown on the Drawings and in accordance with referenced Standard Specifications. Chain link fabric and barbed wire shall be stretched with mechanical equipment.
 1. Install chain-link fencing to comply with ASTM F567 and more stringent requirements specified.
 2. Install fencing on established boundary lines inside property line.
- B. The area to be fenced shall be uniformly and smoothly finish graded before beginning the fence installation. Fence shall be installed after roadway surfacing has been completed. Except where crossing a drainage ditch, the finish grade shall not deviate from a straight line by more than 3 inches. Where crossing a drainage ditch, a line post shall be provided at the top of slope on each side and the fabric shall follow a straight line between the posts. Within the ditch, short post sections shall be embedded to a depth of 4 feet at a maximum spacing of 12 inches on center across the ditch. Posts shall be long enough to overlap the fabric by 12 inches, and each post shall be fastened to the fabric by a minimum of 3 tie bands.
- C. Corner and end post assemblies and the panels on each side of all gates shall be as detailed on the Drawings and in accordance with referenced Standard Specifications. Line posts at 1,000-foot maximum intervals shall have top braces and cross truss rods with turnbuckles even though fabric is stretched with mechanical equipment. Top brace shall remain in place after fence is completed.
- D. All posts shall be embedded into the ground in concrete footings as shown on the Drawings. Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil. Install fence posts at 10-foot maximum spacing in the area of travel of rolling gates. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
- E. CONCRETE FILL: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
 1. EXPOSED CONCRETE: Extend 2 inches above grade; shape and smooth to shed water.

2. Allow concrete footings to cure for seven days before installing fence.
- F. Locate terminal end, corner, and gate posts per ASTM F567 and terminal pull posts at changes in horizontal or vertical alignment of 15 degrees or more.
- G. Space line posts uniformly at 10 feet maximum on center.
- H. POST BRACING AND INTERMEDIATE RAILS:
 1. Install according to ASTM F567, maintaining plumb position and alignment of fencing. Install braces at end and gate posts and at both sides of corner and pull posts.
 - a. Locate horizontal braces at mid-height of fabric 6 feet or higher, on fences with top rail and at 2/3 fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.
- I. TOP RAIL: Install according to ASTM F567, maintaining plumb position and alignment of fencing. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.
- J. Fence fabric shall be securely fastened to the outward side of the posts with the lower edge at the ground level. Leave 1 inch between finish grade or surface and bottom selvage, unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released. Fencing and gates shall be properly braced to prevent sagging.
- K. TENSION OR STRETCHER BARS: Thread through fabric and secure to end, corner, pull, and gate posts with tension bands spaced not more than 15 inches on center.
- L. TIE WIRES:
 1. Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric per ASTM F626. Bend ends of wire to minimize hazard to individuals and clothing.
 - a. MAXIMUM SPACING: Tie fabric to line posts at 12 inches on center and to braces at 24 inches on center.
- M. FASTENERS: Install nuts for tension bands and carriage bolts on the side of the fence opposite the fabric side.
- N. Demonstrate that all gates swing smoothly or roll freely without binding or dragging, that all gates are lockable, and that all gate hardware operates properly. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Demonstrate that all gate operators function properly.

- O. Surplus excavated material remaining after the fence has been constructed shall be disposed of as specified in with state and local regulations.

3.04 GROUNDING AND BONDING

A. FENCE GROUNDING:

1. Install at maximum intervals of 1,500 feet except as follows:
 - a. Fences within 100 feet of buildings, structures, walkways, and roadways: Ground at maximum intervals of 750 feet.
 - 1) Gates and other fence openings: Ground fence on each side of opening.
 - a) Bond metal gates to gate posts.
 - b) Bond across openings, with and without gates, except openings indicated as intentional fence discontinuities. Use no. 2 awg wire and bury it at least 18 inches below finished grade.
 2. Protection at crossings of overhead electrical power lines: Ground fence at location of crossing and at a maximum distance of 150 feet on each side of crossing.
 - 3.

B. GROUNDING METHOD:

1. At each grounding location, drive the specified ground rod vertically until the top is 6 inches is below finished grade. Connect rod to fence with no. 6 awg conductor. Connect conductor to each fence component at the grounding location.

C. CONNECTIONS:

1. Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
 - a. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
 - b. Make connections with clean, bare metal at points of contact.
 - c. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 - d. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
 - e. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

3.05 FIELD ADJUSTMENTS

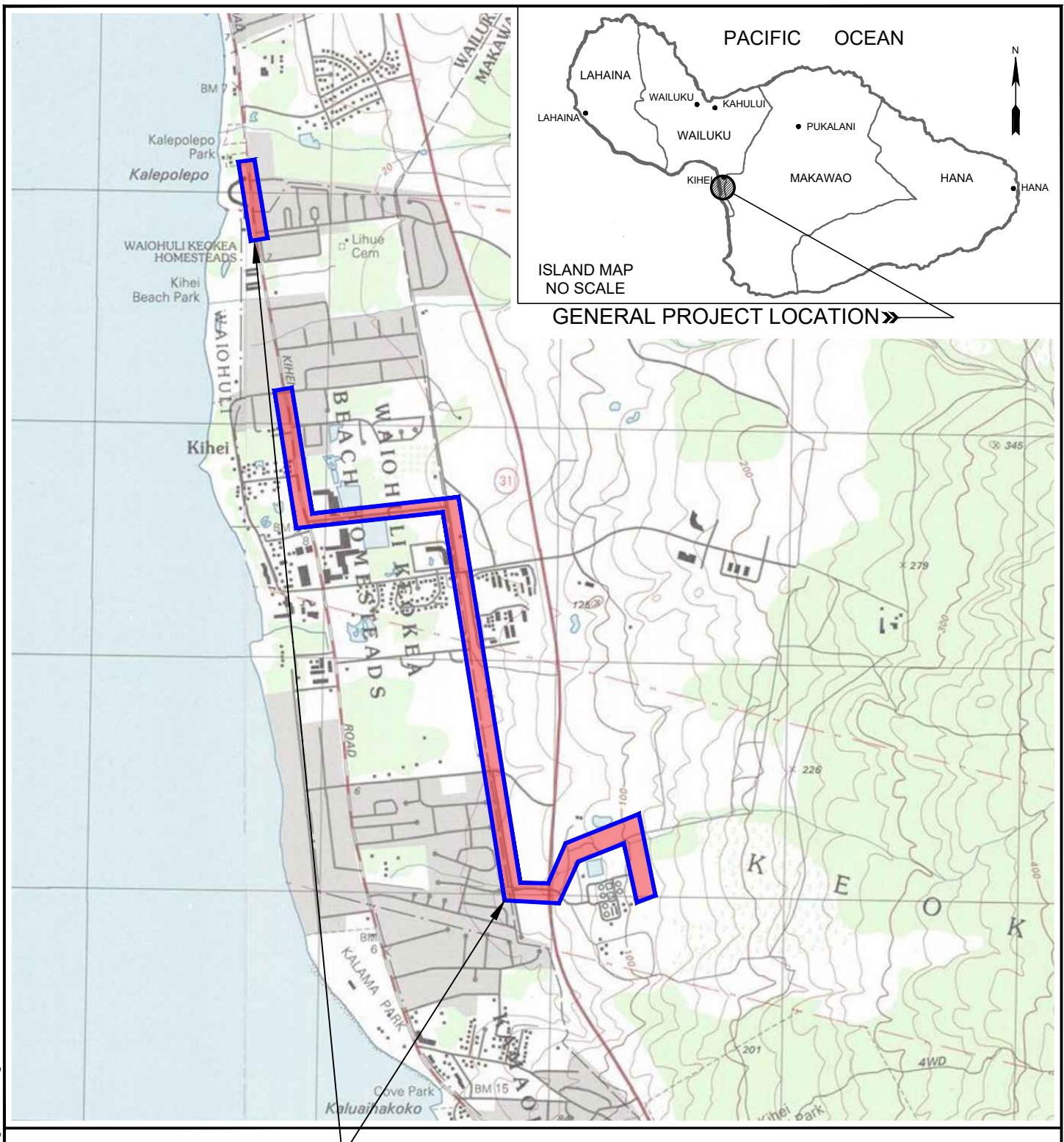
- #### A. GATE:
- Adjust gate to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that

latches and locks engage accurately and securely without forcing or binding.

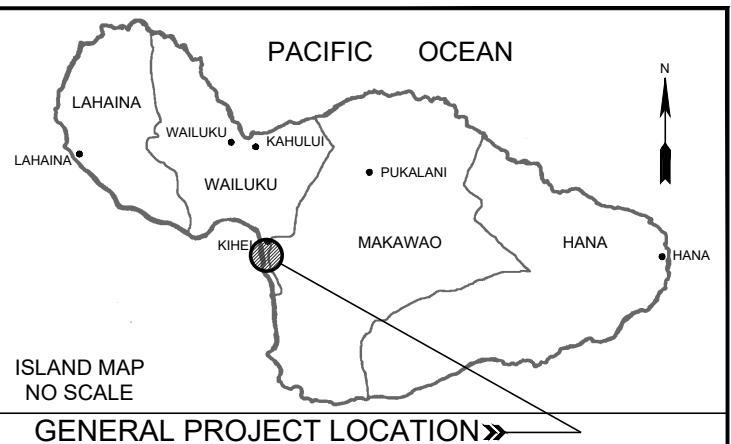
3.06 TRAINING SERVICES

- A. Engage a factory-authorized service representative to train Owner's personnel to adjust, operate, and maintain gates.

END OF SECTION



PROJECT LOCATIONS»



GENERAL PROJECT LOCATION»

PROJECT LOCATION MAP

NORTH KIHEI MAUKA TRANSMISSION SYSTEM
KIHEI, MAUI, HAWAII

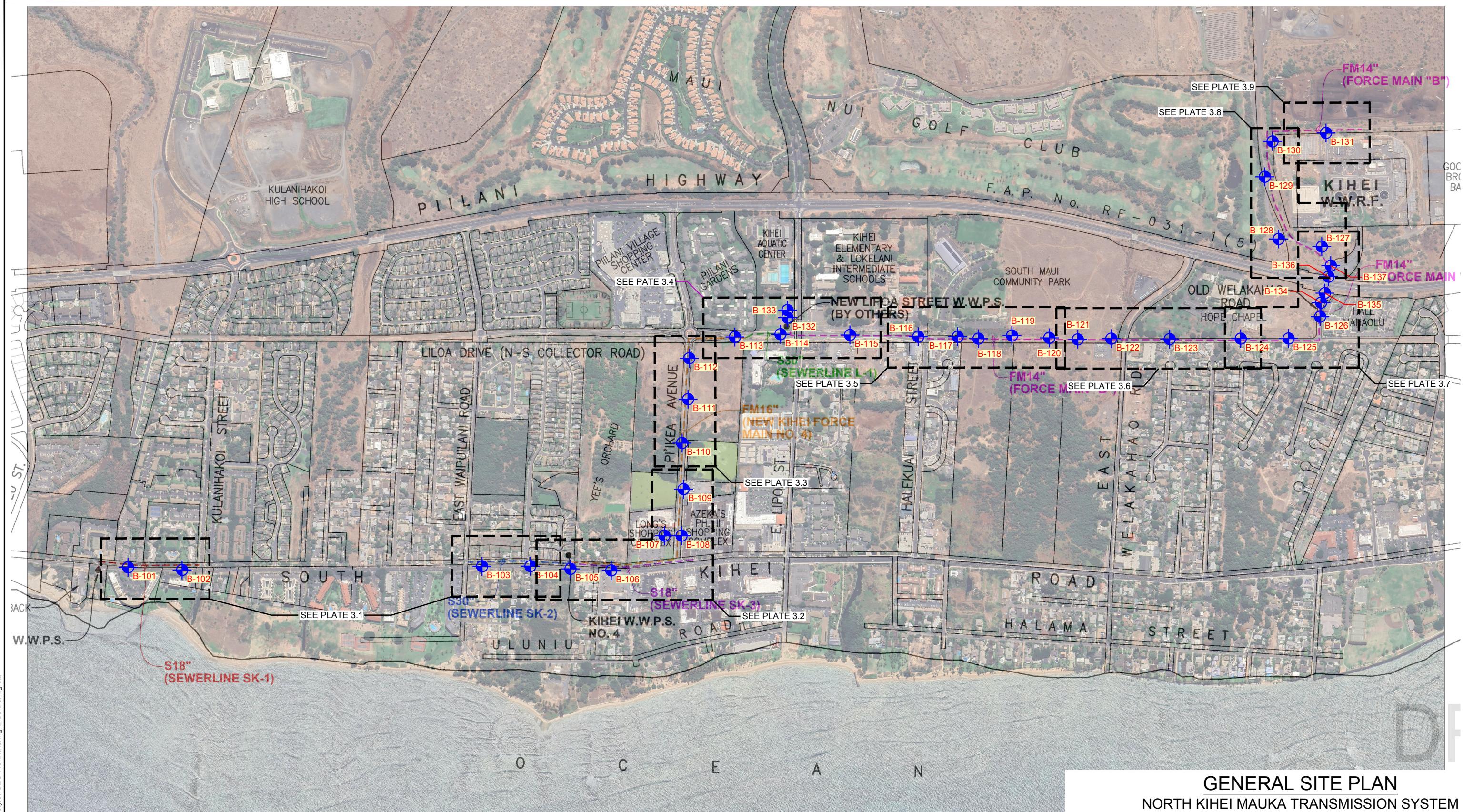
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GRAPHIC SCALE



GEOLABS, INC.

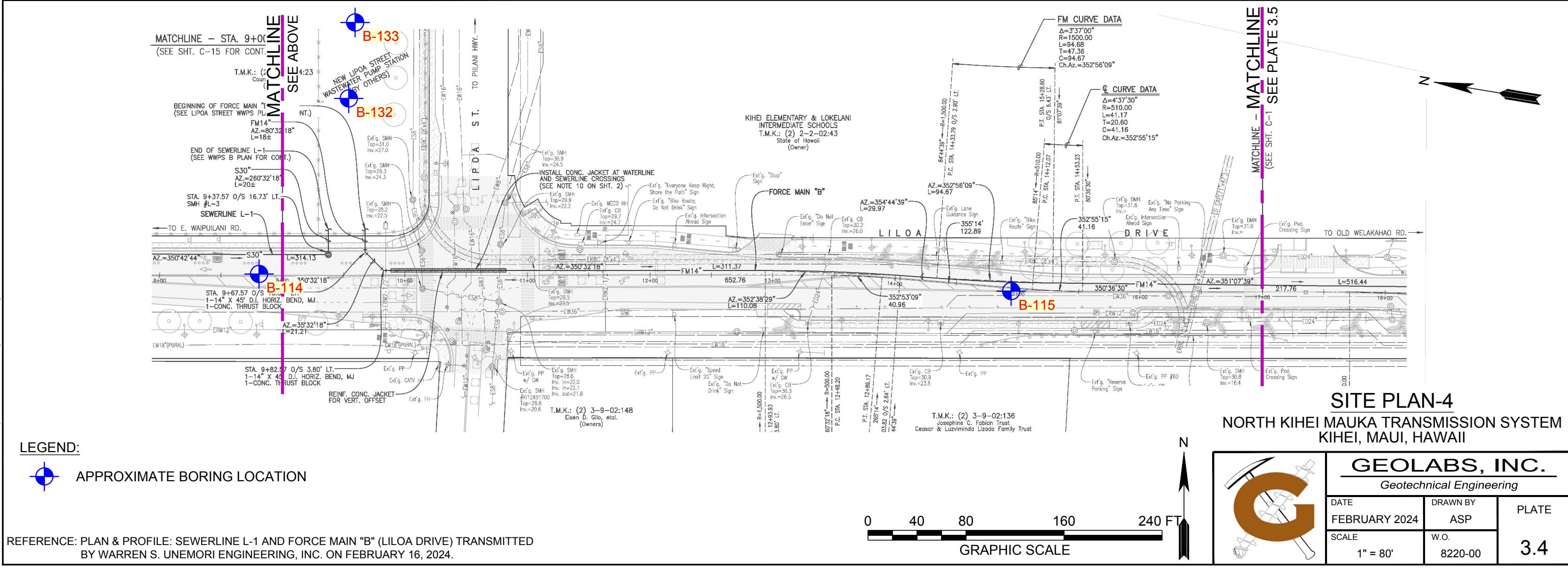
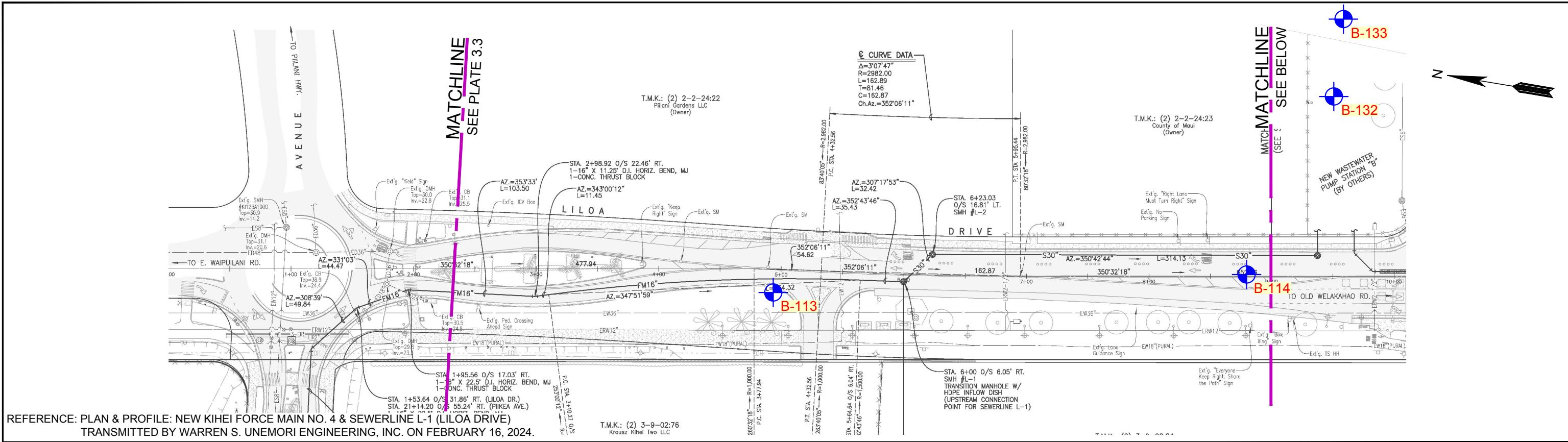
Geotechnical Engineering

DATE FEBRUARY 2024	DRAWN BY HYC	PLATE
SCALE 1" = 2,000'	W.O. 8220-00	
		1



0 400 800 1600 2400 FT.
 GRAPHIC SCALE

GEOLABS, INC.		DATE	DRAWN BY	PLATE
<i>Geotechnical Engineering</i>		FEBRUARY 2024	ASP	
SCALE	1" = 800'	W.O.	8220-00	2





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NORTH KIHEI MAUKA TRANSMISSION SYSTEM KIHEI, MAUI, HAWAII

Log of Boring

113



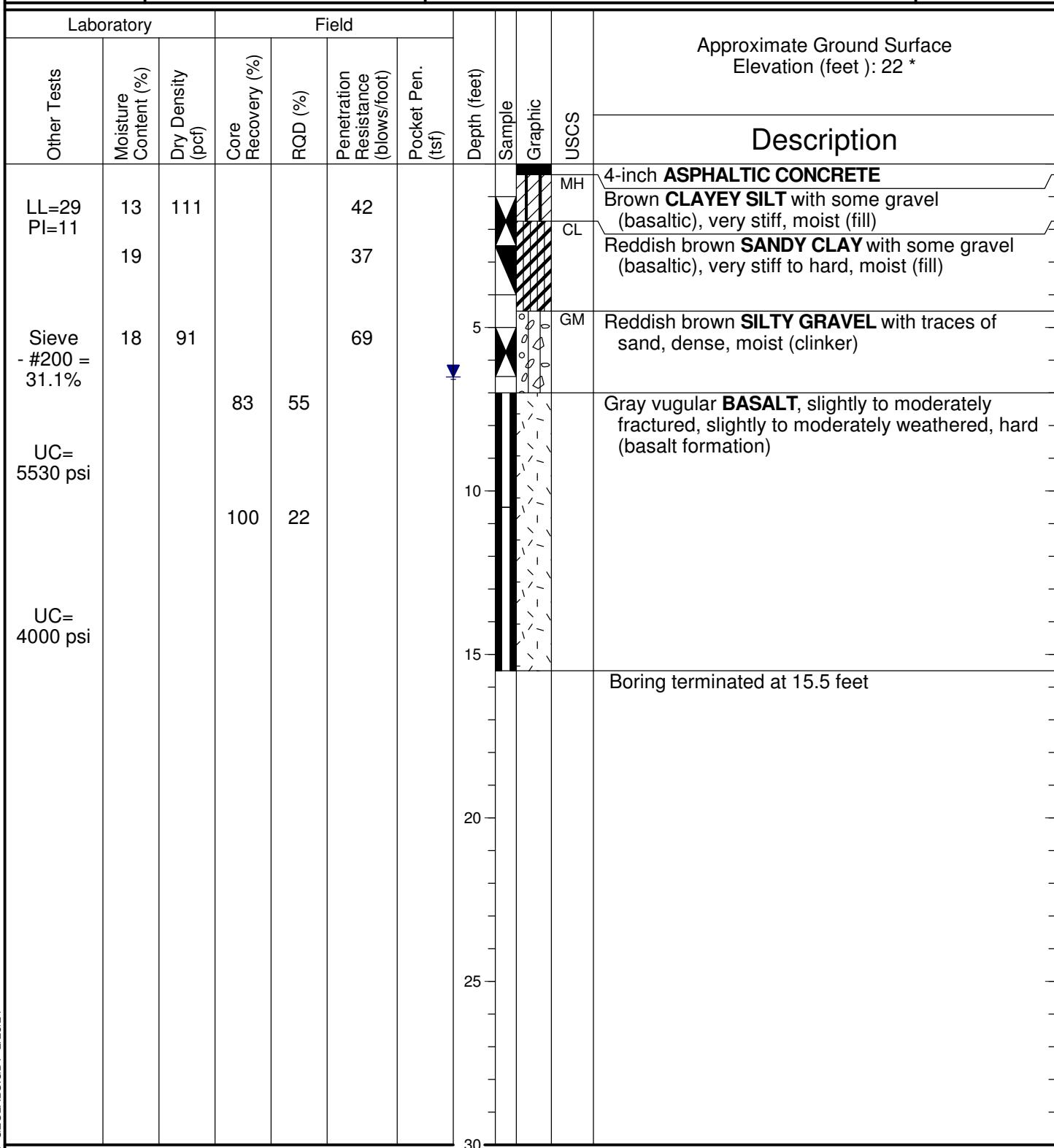
GEOLABS, INC.

Geotechnical Engineering

NORTH KIHEI MAUKA TRANSMISSION SYSTEM
KIHEI, MAUI, HAWAII

Log of
Boring

114



Date Started: September 13, 2023

Date Completed: September 13, 2023

Logged By: P. Young

Total Depth: 15.5 feet

Work Order: 8220-00

Water Level: ▼ 6.5 ft. 09/13/2023 1405 HRS

Drill Rig: CME-45C TRUCK (Energy Transfer Ratio = 86.4%)

Drilling Method: 4" Solid-Stem Auger & PQ Coring

Driving Energy: 140 lb. wt., 30 in. drop

Plate

A - 14

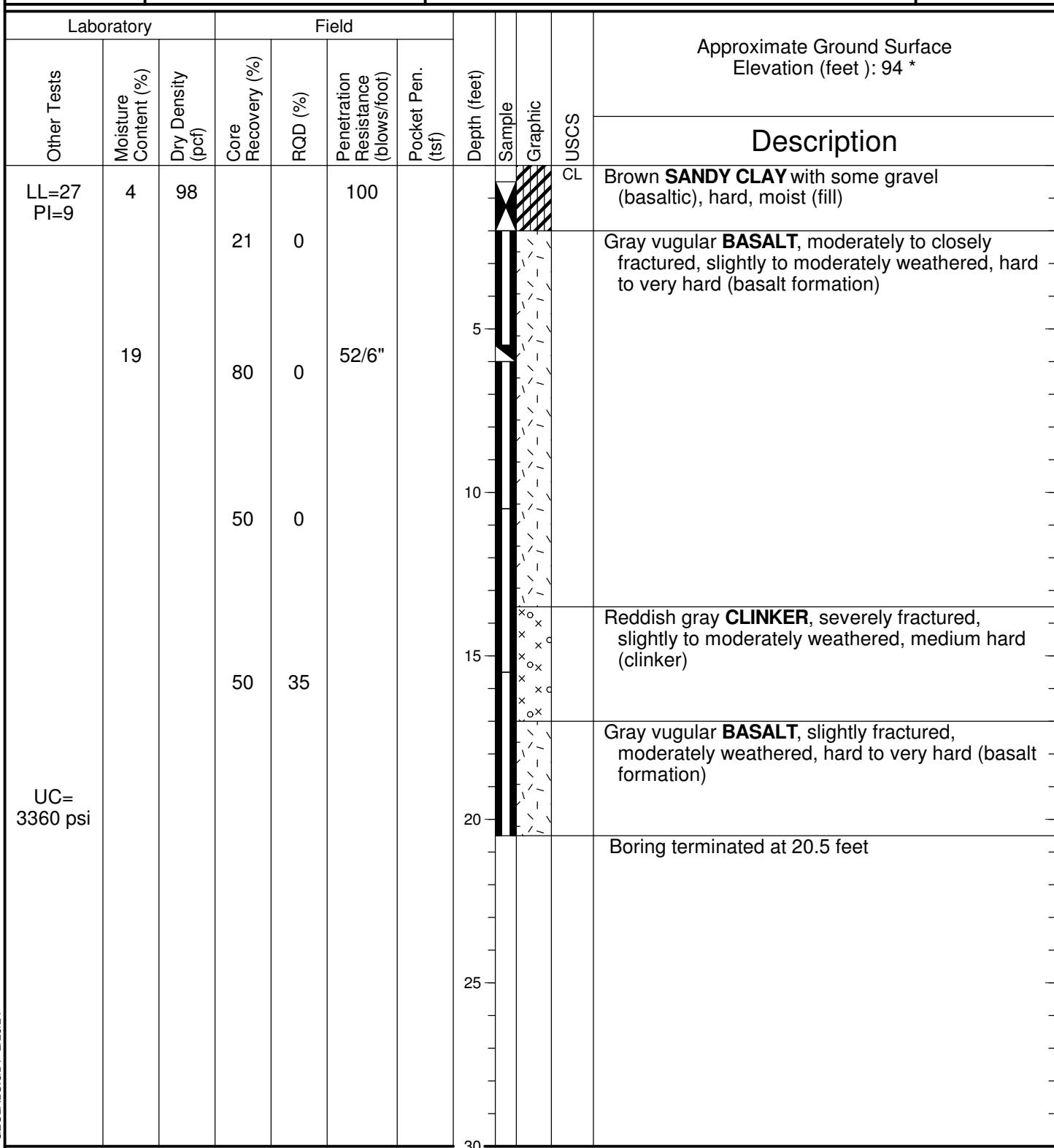


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NORTH KIHEI MAUKA TRANSMISSION SYSTEM
KIHEI, MAUI, HAWAIILog of
Boring

132



Date Started: September 5, 2023

Date Completed: September 5, 2023

Logged By: P. Young

Total Depth: 20.5 feet

Work Order: 8220-00

Water Level: ▼ Not Encountered

Drill Rig: CME-45C TRUCK (Energy Transfer Ratio = 86.4%)

Drilling Method: 4" Solid-Stem Auger & PQ Coring

Driving Energy: 140 lb. wt., 30 in. drop

Plate

A - 32



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Log of Boring

133

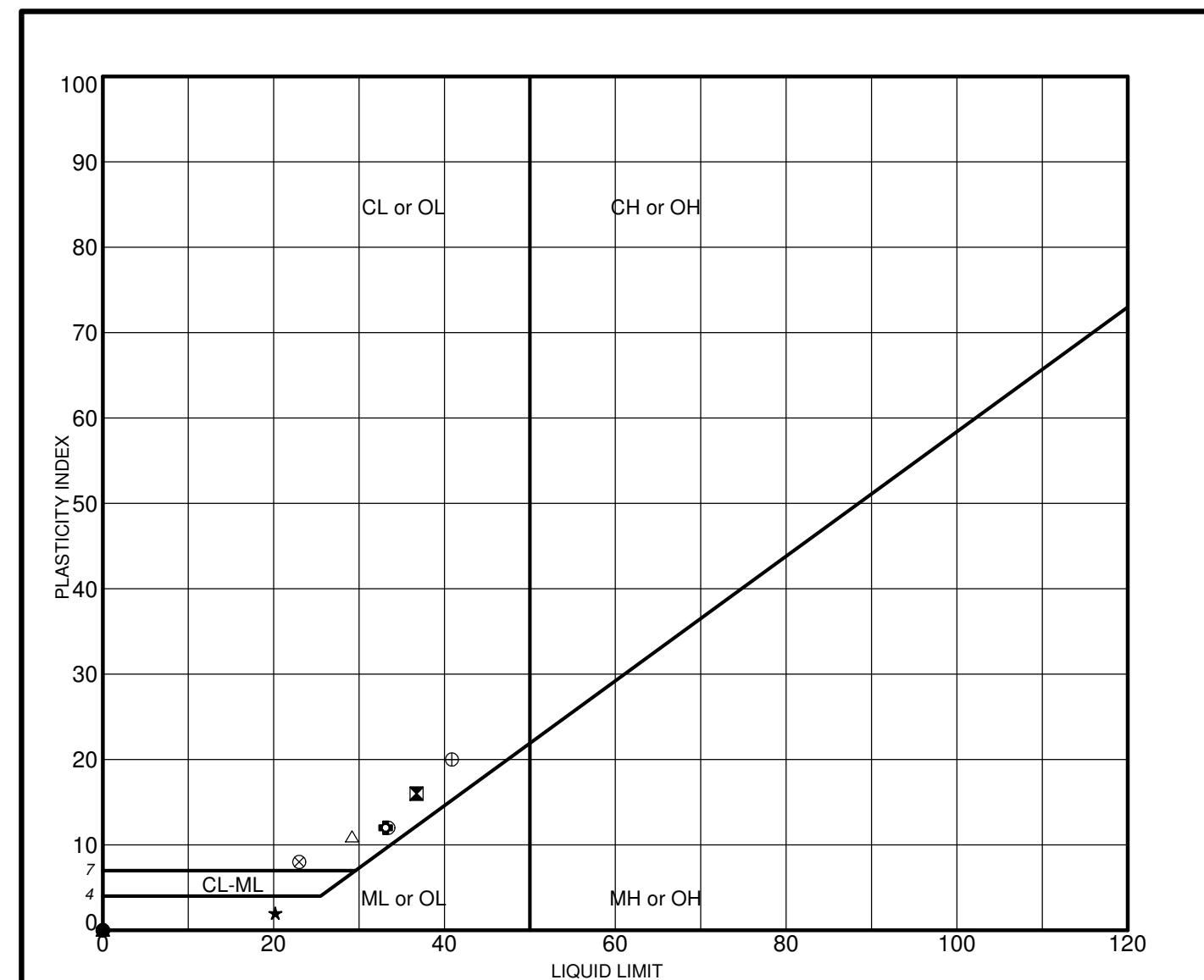
Laboratory		Field					Depth (feet)	Sample	Graphic	USCS	Approximate Ground Surface Elevation (feet): 77 *
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)					
Sieve - #200 = 40.0% LL=47 PI=18	14	101			57					GM	Brown SILTY GRAVEL (BASALTIC) with some sand, dense, moist (fill)
	17				16					ML	Brown SANDY SILT with some gravel (basaltic), very stiff, moist (fill)
UC= 6250 psi			0	0	10		5				Gray vugular BASALT , moderately to closely fractured, slightly to moderately weathered, hard to very hard (basalt formation)
			100				10				
			60	0			15				
			73	53			20				Reddish brown CLINKER , severely fractured, moderately weathered, hard (clinker)
			100	83			25				Gray vugular BASALT , slightly to moderately fractured, moderately to slightly weathered, hard to very hard (basalt formation)
UC= 2900 psi							30				
UC= 9290 psi			63	23							

BOURING LOG 82220-00.GPJ GEOLABS.GDT 2/23/24

Date Started:	September 5, 2023	Water Level: ▼ Not Encountered
Date Completed:	September 5, 2023	
Logged By:	P. Young	Drill Rig: CME-45C TRUCK (<i>Energy Transfer Ratio = 86.4%</i>)
Total Depth:	40.5 feet	Drilling Method: 4" Solid-Stem Auger & PQ Coring
Work Order:	8220-00	Driving Energy: 140 lb. wt., 30 in. drop

Plate

A - 33.1

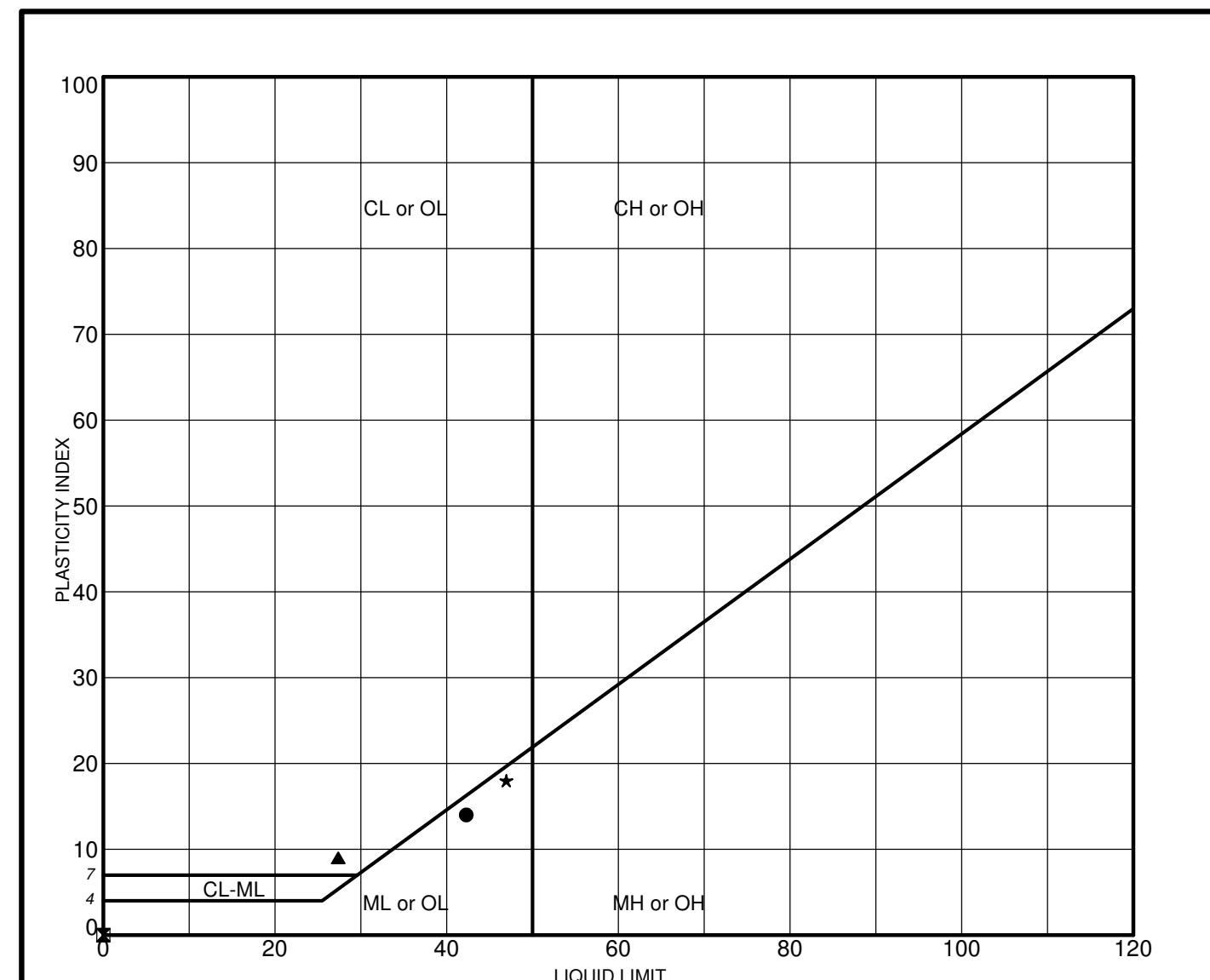


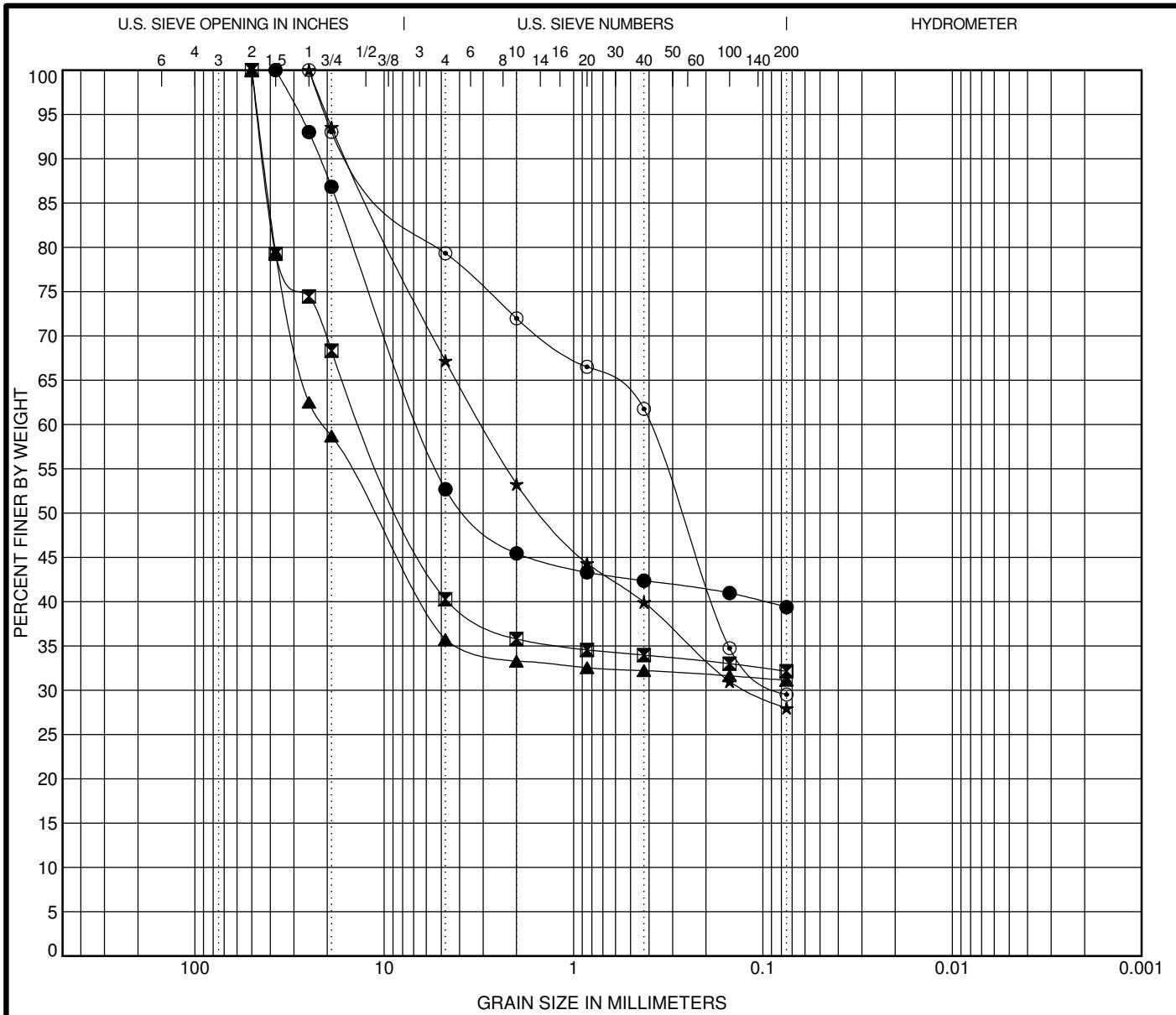
G. ATTERBERG PL-100 LL-120 8220-00 GEO LABS.GDT 2/23/24

	Sample	Depth (ft)	LL	PL	PI	Description
●	B-103	20.5-22.5	NP	NP	NP	Light gray sandy silt (NP)
■	B-108	2.5-4.0	37	21	16	Reddish brown sandy clay (CL) with some gravel
▲	B-109	3.5-5.5	NP	NP	NP	Brown with gray mottling silty sand (NP) with traces of clay
★	B-110	2.5-4.0	20	18	2	Brown sandy silt (ML) with some gravel
○	B-110	5.0-6.5	NP	NP	NP	Brown sandy silt (NP) with some gravel
◆	B-112	2.5-4.0	33	21	12	Reddish brown silty clay (CL) with some gravel
○	B-113	2.0-3.5	33	21	12	Reddish brown sandy clay (CL) with some gravel
△	B-114	1.0-2.5	29	18	11	Reddish brown sandy clay (CL) with some gravel
⊗	B-115	1.0-2.5	23	15	8	Reddish brown sandy clay (CL) with some gravel
⊕	B-117	1.0-2.5	41	21	20	Reddish brown gravelly clay (CL) with some sand

NP = NON-PLASTIC

	GEOLABS, INC. GEOTECHNICAL ENGINEERING W.O. 8220-00	ATTERBERG LIMITS TEST RESULTS - ASTM D4318	
		NORTH KIHEI MAUKA TRANSMISSION SYSTEM KIHEI, MAUI, HAWAII	Plate B - 1





GRAIN SIZE MOD 8220-00 GRU GEOLABS GDT 2/23/24

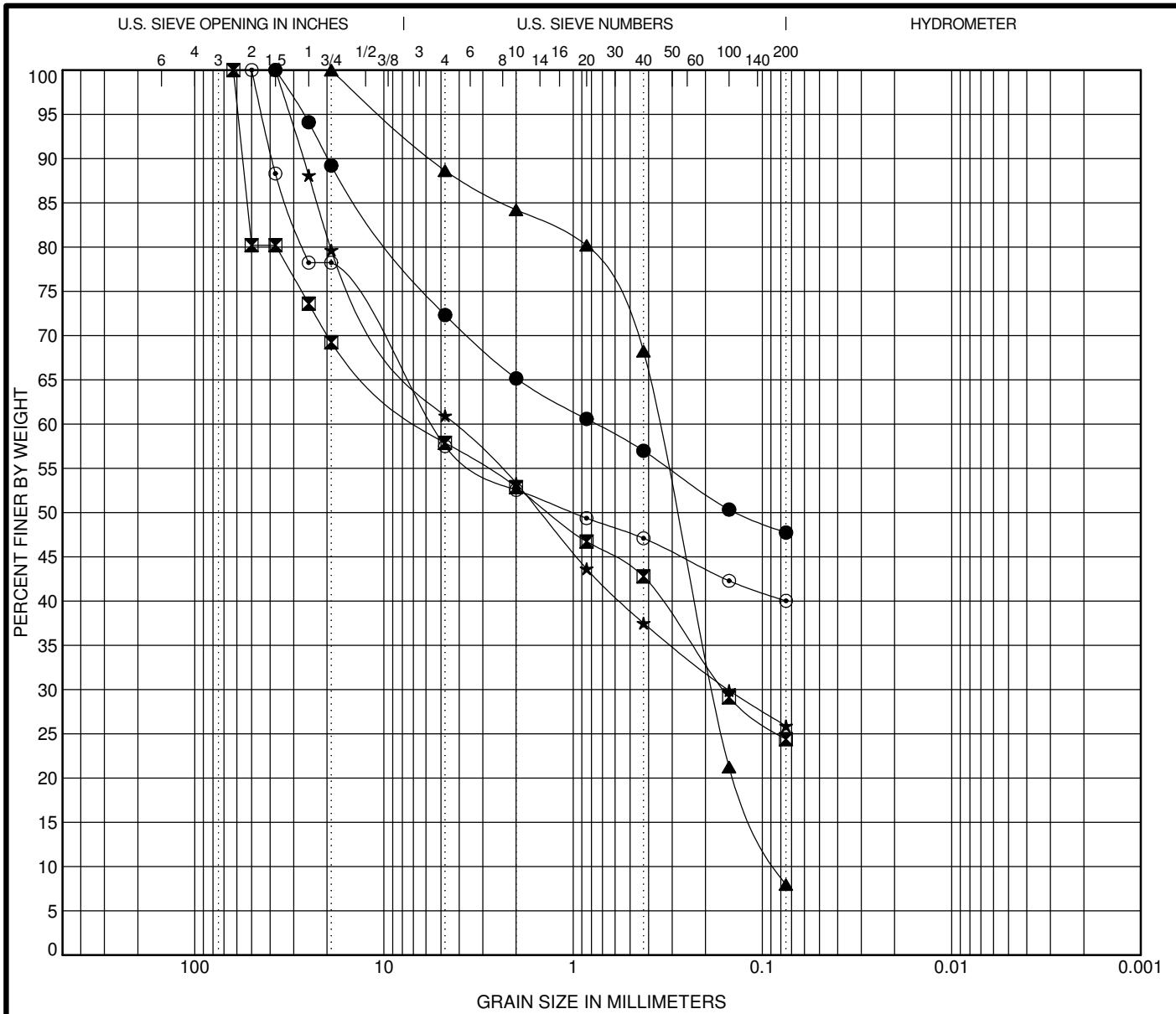


GEOLABS, INC.
GEOTECHNICAL ENGINEERING
W.O. 8220-00

GRAIN SIZE DISTRIBUTION - ASTM D6913

NORTH KIHEI MAUKA TRANSMISSION SYSTEM
KIHEI, MAUI, HAWAII

Plate
B - 5



COBBLES	GRAVEL		SAND			SILT OR CLAY			
	coarse	fine	coarse	medium	fine				

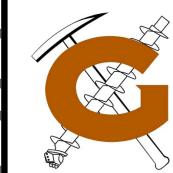
Sample	Depth (ft)	Description						LL	PL	PI	Cc	Cu
● B-122	2.5-4.0	Light brown silty gravel (GM) with some sand										
■ B-123	1.0-2.5	Brown silty gravel (GM) with some sand										
▲ B-123	5.0-6.5	Tannish brown sand (SP-SM) with a little gravel and silt									1.1	4.2
★ B-126	1.5-3.5	Brown silty gravel (GM) with some sand										
○ B-133	0.5-2.0	Brown silty gravel (GM) with some sand										
Sample	Depth (ft)	D100 (mm)	D60 (mm)	D30 (mm)	D10 (mm)	%Gravel	%Sand	%Fine				
● B-122	2.5-4.0	37.5	0.76			27.7	24.6	47.7				
■ B-123	1.0-2.5	62.5	6.157	0.16		42.1	33.5	24.4				
▲ B-123	5.0-6.5	19	0.354	0.182	0.083	11.4	80.7	7.9				
★ B-126	1.5-3.5	37.5	4.269	0.152		39.1	35.0	25.9				
○ B-133	0.5-2.0	50	5.616			42.5	17.5	40.0				



Location	Depth	Length	Diameter	Length/ Diameter Ratio	Density	Load	Compressive Strength
	(feet)	(inches)	(inches)		(pcf)	(lbs)	(psi)
B-111	9 - 9.5	6.590	3.280	2.01	177.2	70,325	8,320
B-112	11 - 11.52	6.520	3.260	2.00	185.6	134,005	16,050
B-113	8 - 8.5	6.520	3.260	2.00	173.5	183,750	22,010
B-113	14 - 14.5	6.540	3.270	2.00	182.3	151,870	18,080
B-114	8.5 - 9	6.540	3.270	2.00	165.0	46,460	5,530
B-114	13.5 - 14	6.520	3.260	2.00	175.8	33,385	4,000
B-117	9.5 - 10	6.520	3.260	2.00	177.3	43,675	5,230
B-118	4 - 6	6.540	3.270	2.00	165.2	101,790	12,120
B-118	9.5 - 10	6.540	3.270	2.00	183.9	123,060	14,650
B-120	5.5 - 6	6.520	3.260	2.00	165.7	43,080	5,160
B-121	13 - 16.5	6.520	3.260	2.00	181.5	98,585	11,810
B-122	6.5 - 7	6.540	3.270	2.00	164.3	48,975	5,830
B-122	14 - 14.5	6.540	3.270	2.00	171.3	106,460	12,680
B-123	6.75 - 7.3	6.540	3.270	2.00	94.5	22,385	2,670
B-123	14 - 14.5	6.560	3.280	2.00	116.8	43,780	5,180
B-124	4 - 4.5	6.500	3.250	2.00	171.1	71,785	8,650
B-124	7.5 - 8	6.540	3.270	2.00	117.1	27,040	3,220
B-124	10.75 - 11.3	6.540	3.270	2.00	153.9	57,920	6,900
B-125	8 - 8.5	6.540	3.270	2.00	146.1	44,210	5,260
B-126	13 - .13.5	6.700	3.270	2.05	129.4	22,515	2,680
B-132	19 - 19.5	6.520	3.260	2.00	143.4	28,005	3,360
B-133	18 - 18.5	6.540	3.270	2.00	170.8	52,515	6,250
B-133	23.5 - 24	6.500	3.250	2.00	184.2	24,055	2,900
B-133	28 - 28.5	6.520	3.260	2.00	162.2	77,540	9,290
B-133	32 - 32.5	6.540	3.270	2.00	172.4	123,045	14,650
B-133	37 - 37.5	6.560	3.280	2.00	178.8	143,520	16,990
B-134	5 - 5.5	6.500	3.280	1.98	138.4	34,325	4,060

ASTM D7012 (METHOD C)

Note: Samples were not prepared in accordance with ASTM D4543. Therefore, results reported may differ from results obtained from a test specimen that meets the requirements of Practice D4543



GEOLABS, INC.

GEOTECHNICAL ENGINEERING

W.O. 8220-00

UNIAXIAL COMPRESSIVE STRENGTH TEST

NORTH KIHEI MAUKA TRANSMISSION SYSTEM
KIHEI, MAUI, HAWAII

Plate
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NORTH KIHEI MAUKA TRANSMISSION SYSTEM
KIHEI, MAUI, HAWAII

B-111 6.5' TO 15.0'



B-112 10.0' TO 15.0'



B-113 7.0' TO 15.0'



NORTH KIHEI MAUKA TRANSMISSION SYSTEM
KIHEI, MAUI, HAWAII

B-114 7.0' TO 15.5'



B-115 13.0' TO 15.0'

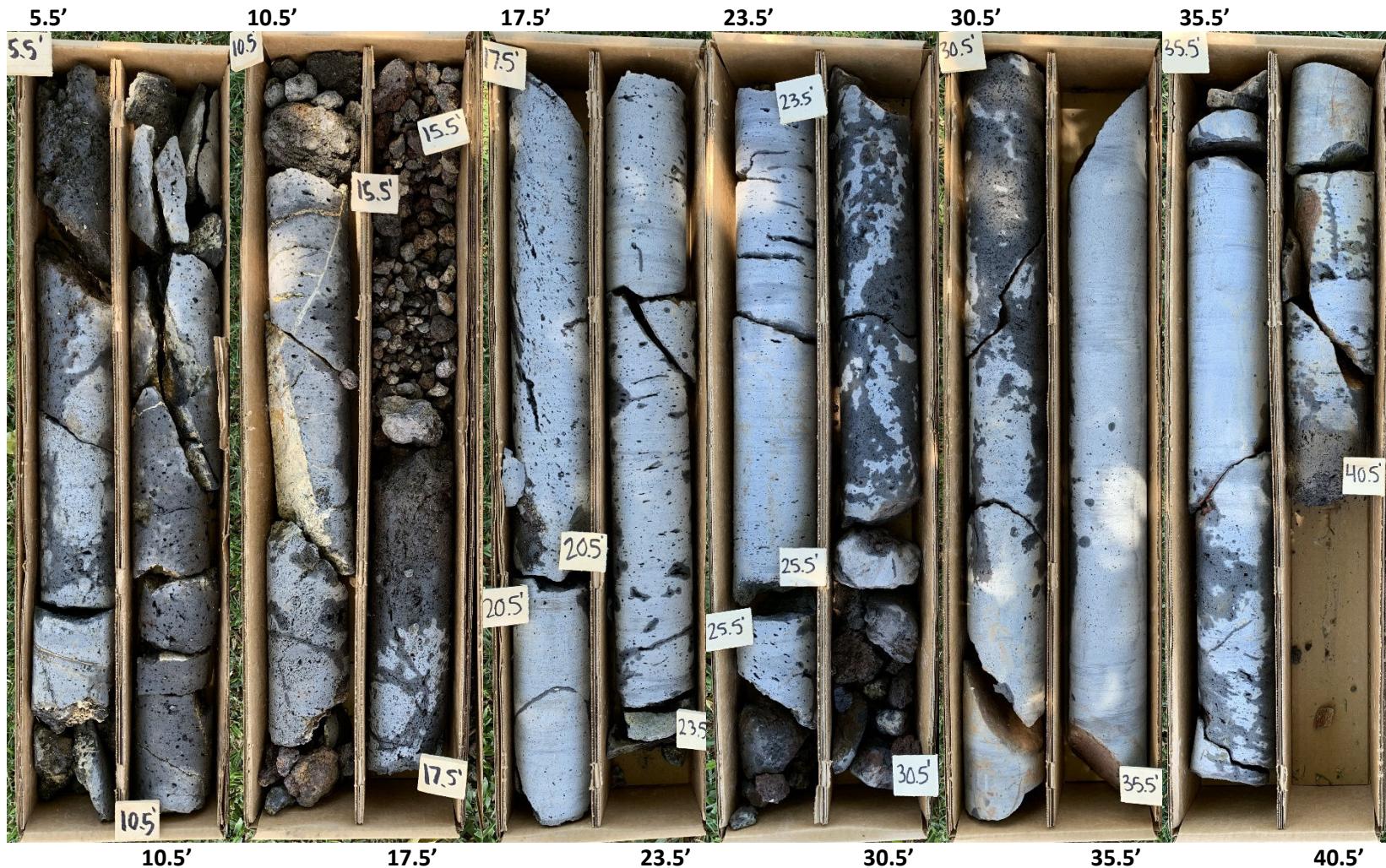


B-116 5.75' TO 15.0'



NORTH KIHEI MAUKA TRANSMISSION SYSTEM
KIHEI, MAUI, HAWAII

B-133 5.5' TO 40.5'



DIVISION 3 - CONCRETE

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mix design, placement procedures, and finishes.

1.02 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume.

1.03 SUBMITTALS

- A. Product Data:

- 1. Reinforcing steel - Certified mill test results or laboratory test results. Indicate bar size, yield strength, ultimate tensile strength, elongation and bend test. Provide chemical composition for rebars that are to be welded.

- B. Design Mixes: For each concrete mix. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

- 1. Indicate amounts of mix water to be withheld for later addition at Project site.

- C. Steel Reinforcement Shop Drawings: Details of fabrication, bending, and placement, prepared according to ACI 315, "Details and Detailing of Concrete Reinforcement." Include material, grade, bar schedules, stirrup spacing, bent bar diagrams, arrangement, and supports of concrete reinforcement. Include special reinforcement required for openings through concrete structures.

- D. Welding Certificates: Copies of certificates for welding procedures and personnel.

- E. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:

- 1. Form materials and form-release agents.
 - 2. Steel reinforcement and reinforcement accessories.

3. Curing materials.
4. Adhesives.
5. Vapor retarders.
6. Epoxy joint filler.
7. Repair materials.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.
- B. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated.
 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
- C. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.
- D. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel."
- E. ACI Publications: Comply with the following, unless more stringent provisions are indicated and maintain a copy at the field office.
 1. ACI 301, "Specification for Structural Concrete."
 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
 3. ACI 347R "Guide to Formwork for Concrete"

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle steel reinforcement to prevent bending, damage and corrosion.
 1. Avoid damaging coatings on steel reinforcement.

PART 2 – PRODUCTS

2.01 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Comply with ACI 347R. Provide new or good finish form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 - 1. Plywood, metal, or other ACI 347R approved panel materials.
 - 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. High-density overlay, Class 1, or better.
 - b. Medium-density overlay, Class 1, or better, mill-release agent treated and edge sealed.
 - c. Structural 1, B-B, or better, mill oiled and edge sealed.
 - d. B-B (Concrete Form), Class 1, or better, mill oiled and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- D. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces. Form oils or waxes shall not be used for concrete surfaces intended to be painted.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- E. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of the exposed concrete surface.
 - 2. Furnish ties that, when removed, will leave holes not larger than ½ inch in diameter in concrete surface.

2.02 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed, unless otherwise noted on the drawings.

2.03 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place that will not puncture the vapor retarder. Use plastic straps or brightly colored tie wires to secure reinforcing. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected or CRSI Class 2 stainless-steel bar supports.

2.04 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I-II.
- B. Pozzolans
 - 1. Fly Ash: ASTM C 618, Class C or F.
- C. Normal-Weight Aggregate: ASTM C 33, uniformly graded, and as follows:
 - 1. Class: Moderate weathering region, but not less than 3M.
 - 2. Aggregate Size: No. 57 (1 inch to No. 4).
- D. Size of Coarse Aggregate: Except when otherwise specified or permitted, maximum size of coarse aggregate shall not exceed three-fourths of the minimum clear spacing between reinforcing bars (or bundled bars), one-fifth of the narrowest dimension between the sides of forms, or one-third of the thickness of slabs or toppings.
- E. Water: Potable and complying with ASTM C 94 or non potable meeting ASTM C-94 Acceptance Criteria for Questionable Water Supply. Use only potable water for job site mixing.

2.05 ADMIXTURES

- A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material and to be compatible with other admixtures and cementitious materials. Do not use admixtures containing calcium chloride.
- B. Water-Reducing Admixture: ASTM C 494, Type A.

- C. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
- D. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E.
- E. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.

2.06 VAPOR RETARDERS

- A. Vapor Retarder: ASTM E 1745, Class A except as modified in Subparagraph 1. below, nylon- or polyester-cord-reinforced three-ply high-density polyethylene sheet or one-ply extruded polyolefin sheet; 15 mil minimum thickness. Compliance to ASTM standards shall be confirmed by an independent testing agency.
 - 1. Permeance Rating: ASTM E96, ASTM E154 not exceeding 0.03 grains/ft²/hr

2.07 CURING MATERIALS AND EVAPORATION RETARDERS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.

2.08 RELATED MATERIALS

- A. Epoxy Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Shore A hardness of 80 per ASTM D 2240.
- B. Cementitious Coatings: Cement based polymer modified concrete finishing materials. Available Products subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

ProFinish by Bonded Materials

- C. Sleeves:
 - 1. Schedule 40 pipe, galvanized per ASTM A53.
 - 2. Schedule 40 PVC Pipe.

- D. Epoxy Bonding Adhesive for Reinforcing Steel Dowels: ASTM C 881, two component epoxy resin, capable of humid curing and bonding to damp surfaces such as:

"Simpson SET-3G" by Simpson Strong-Tie Company.

2.09 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations. Products shall contain no added gypsum.
1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
 4. Compressive Strength: Not less than 4000 psi (27.6 MPa) at 28 days when tested according to ASTM C 109/C 109M.
- B. Repair Topping: Traffic-bearing, cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch. Products shall contain no added gypsum.
1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
 4. Compressive Strength: Not less than 5500 psi (39 MPa) at 28 days when tested according to ASTM C 109/C 109M.

2.10 CONCRETE MIXES

- A. Prepare design mixes for each type and strength of concrete determined by either laboratory trial mix or field test data bases, as follows:
1. Proportion normal-weight concrete according to ACI 211.1 and ACI 301.

- B. Footings and Foundation Walls: Proportion normal-weight concrete mix as follows:
 - 1. Compressive Strength (28 Days): 4000 psi.
- C. Slab-on-Grade: Proportion normal-weight concrete mix as follows:
 - 1. Compressive Strength (28 Days): 4000 psi.
- D. Suspended Slabs: Proportion normal-weight concrete mix as follows:
 - 1. Compressive Strength (28 Days): 4000 psi.
- E. Building Frame Members: Proportion normal-weight concrete mix as follows:
 - 1. Compressive Strength (28 Days): 4000 psi.
- F. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 - 1. Fly Ash: 25 percent.
 - 2. Combined Fly Ash and Pozzolan: 25 percent.
- G. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing admixture or high-range water-reducing admixture (superplasticizer) in concrete, as required, for placement and workability.
 - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - 3. Use water-reducing admixture in pumped concrete and concrete with a water-cementitious materials ratio below 0.50.

2.11 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.12 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94, and ASTM C 1116 and furnish batch ticket information. Batch ticket information shall include design mix reference, water that can be added at the jobsite, and admixtures. For transit mixing, complete not less than 70 revolutions of the drum at the manufacturer's rated mixing speed. Discharge concrete into its final position within 90 minutes after introduction of batch water to the cement. If a retarder

- admixture is used, the discharge time limit of 90 minutes may be increased by the time specified for retardation by the admixture manufacturer or the concrete supplier. Mix concrete a minimum of one minute at mixing speed immediately prior to discharge.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials according to ASTM C 94. Mix concrete materials in appropriate drum-type batch machine mixer.
1. For mixer capacity of 1 cu. yd.0.76 cu. m or less, continue mixing at least one and one-half minutes, but not more than five minutes after all ingredients are in mixer, before any part of batch is released.
 2. For mixer capacity larger than 1 cu. yd.0.76 cu. m, increase mixing time by 15 seconds for each additional 1 cu. yd.0.76 cu. m.
 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mix type, mix time, quantity, and amount of water added. Record approximate location of concrete placement in structure.
 4. Hand mixed concrete will not be allowed.

PART 3 – EXECUTIONS

3.01 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows: Class A, 1/8 inch.
- D. Construct forms to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood inserts for forming keyways, reglets, recesses, and the like, for easy removal.
1. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates

- or compacting-type screeds. Maintain the integrity of the vapor retarder membrane.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
 - H. Chamfer exterior corners and edges of permanently exposed concrete.
 - I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the work. Determine sizes and locations from trades providing such items.
 - J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
 - K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
 - L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.02 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor bolts, accurately located, to elevations required.
 - 2. Install inserts, hangers, metal ties, nailing strips, blocking, grounds and other fastening devices needed for attachment of other work.
- B. Locate electrical or mechanical conduits and fittings so that the strength of the concrete member is not impaired. "Conduits" include pipes, ducts, and electrical conduits. Unless required otherwise on the Drawings, conform to the following:
 - 1. Concrete Walls: Do not embed conduits larger than one inch (nominal pipe size) diameter vertically. Place conduits in the middle of the wall and space a minimum of 10 times their outside diameter. Do not embed conduits horizontally in wall lengthwise. Provide sleeve for conduits passing through walls.
 - 2. Concrete Beams: Do not embed conduits larger than 1-1/2 inches outside diameter vertically in any beam. Place conduits in the middle third of the beam depth and space a minimum of 10 times their outside diameter. Do not embed conduits horizontally in beam lengthwise. Provide sleeve for conduits passing through beams.

- 3. Suspended Concrete Slabs and Toppings: Do not embed conduits larger than 1 inch outside diameter s in concrete slab or topping. Conduits shall be spaced a minimum of 10 times their outside diameter. Avoid conduit crossings. Provide sleeve for conduits passing through slabs.
- 4. Concrete Slabs on Grade: Do not embedded conduits within the thickness of any concrete slab on grade. Place conduits in the subgrade below the concrete slabs, but not within the thickness of the basaltic termite barrier.
- C. Obtain Project Engineer's and Architect's approval to install conduit or pipe penetrations that may unduly impair the strength of the structural member.

3.03 REMOVING AND REUSING FORMS

- A. General: Formwork, for sides of beams, walls, columns, and similar parts of the Work, that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F(10 deg C) for 24 hours after placing concrete provided concrete is hard enough to not be damaged by form-removal operations and provided curing and protection operations are maintained. The 24 hour period may be reduced to 12 hours in compliance with ACI 347R with prior approval from the Project Engineer.
- B. Leave formwork, for beam soffits, slabs, and other structural elements, that supports weight of concrete in place until concrete has achieved the following:
 - 1. At least 70 percent of 28-day design compressive strength (minimum requirement).
- C. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- D. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Project Engineer.

3.04 VAPOR RETARDERS

- A. Vapor Retarder: Place, protect, and repair vapor-retarder sheets according to ASTM E 1643 "Standard Practice for Installation of Water Vapor Retarders" and manufacturer's written instructions. The more stringent shall apply.
 - 1. Use the greatest widths and lengths practical to minimize lap joints. Seal laps joints and edges with tape or materials compatible with the vapor retarder. Remove and replace torn, punctured, or

damaged vapor barrier materials, except when minor repairs or patches are allowed by manufacturer's instructions.

2. Do not cut or puncture vapor retarder. No penetrations of the vapor barrier allowed except for reinforcing steel and permanent utilities. Seal all penetrations including pipes and reinforcing. Repair damage and reseal vapor retarder before placing concrete.
3. Do not leave the vapor retarder exposed to ultraviolet radiation for more than a few days prior to the concrete pour. Remove standing water from the vapor retarder prior top concrete pour.

3.05 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
 1. Shop or field-weld reinforcement according to AWS D1.4, where indicated.
 2. Support slab reinforcing bars and welded wire fabric (WWF) as follows:

BAR SIZE	MAXIMUM DISTANCE BETWEEN SUPPORTS
#3	2 feet
#4	3 feet
#5	4 feet

- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

3.06 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Project Engineer.
 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise

- indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 3. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness, as follows:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8 inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

3.07 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed. Provide one day notification to Project Engineer for each scheduled pour.
- B. Before placing concrete, water may be added at Project site, subject to limitations of ACI 301. Up to two gallons of water per cubic yard of concrete may be added at the jobsite provided the approved design mix accommodates the additional water.
 1. Do not add water to concrete after adding high-range water-reducing admixtures to mix.
- C. Convey concrete from mixer to the place of final deposit rapidly by methods that prevent segregation or loss of ingredients and will ensure the required quality of concrete. Use conveying equipment, conveyors, hoppers, baffles, chutes, pumps that are sized and designed to prevent cold joints from occurring and prevent segregation in discharged concrete. Clean conveying equipment before each placement.
- D. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously,

provide construction joints as specified. Deposit concrete to avoid segregation.

E. Deposit concrete in forms in horizontal layers with proper consolidation into previous layers and in a manner to avoid inclined construction joints. Place each layer while preceding layer is still plastic, to avoid cold joints. For high wall pours (above 12 feet), Contractor must show its experience and demonstrate its proficiency before Project Engineer will permit pours in excess of 12 feet.

1. Consolidate placed concrete with mechanical vibrating equipment. Use equipment and procedures for consolidating concrete recommended by ACI 309R.
2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the vibrator. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix constituents to segregate.
3. Make construction joints only where located on Drawings unless otherwise approved by Project Engineer. Plan pours to continuously place concrete from one construction joint to another.

F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screeed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, free of humps or hollows, before excess moisture or bleed-water appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

- G. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows, when hot-weather conditions exist:
1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
 3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.08 CONCRETE SLABS ON GRADE

- A. For interior areas, unless specified elsewhere, place concrete floor slabs directly over vapor retarder overlain atop basaltic termite barrier.
1. Place floor slabs in alternate panels, long strip pattern, and following construction or contraction joints. "Keyed Kold Joint" may be used in lieu of placement in alternate panels in areas where floor covering is specified provided all shrinkage cracks are sealed prior to installation of floor covering.
 2. Provide a bond-break filler strip, between concrete slab and abutting vertical surfaces and as detailed.
- B. For exterior areas, unless specified elsewhere, place concrete floor slabs directly over granular fill or compacted fill and reinforce slabs with synthetic fibers. Provide isolation and contraction joints where detailed and, at intersections, corners and at abutments. Place contraction joints not more than 40 feet apart, unless detailed otherwise.
1. Finish concrete true to grade, section and cross slope for sloped or crowned walks at 1.5% (1% minimum and 2% maximum). Round edges to 1/8" radius except saw-cut joints. Finish steps in connection with walks with same finish as walks.

3.09 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched. Remove fins and other projections exceeding ACI 347R limits for class of surface specified.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum

of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding 1/8 inch in height.

1. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, or painting.
2. Do not apply rubbed finish to smooth-formed finish.

3.10 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched. Remove fins and other projections exceeding ACI 347R limits for class of surface specified.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding 1/8 inch in height.
 1. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, or painting.
- C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.11 FINISHING FLOORS AND SLABS

- A. General: Comply with recommendations in ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes.
 1. Apply scratch finish to surfaces indicated and to surfaces to receive concrete floor topping or mortar setting beds for ceramic or quarry
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
 1. Apply float finish to surfaces indicated, to surfaces to receive trowel finish, and to floor and slab surfaces to be covered with fluid-

applied or sheet waterproofing, buildup or membrane roofing, or sand-bed terrazzo.

- D. Trowel Finish: After applying float finish, apply first trowel finish and consolidate concrete by hand or power-driven trowel. Continue troweling passes and straighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
1. Apply a trowel finish to surfaces indicated and to floor and slab surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin film-finish coating system.
- E. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Project Engineer before application.
- F. Swirled Finish: Apply a swirl finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated. Immediately after second troweling, and when concrete is still plastic, work the surface with a float in semi-circular or fan-like motion.

3.12 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete Work.

3.13 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 305R for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing by one or a combination of the curing methods listed in paragraph 3.13.D.

- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces, by one or a combination of the following methods:
1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moist cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moist cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer recommends for use with floor coverings.
 3. Curing Compound: Apply uniformly in continuous operation by spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application where recommended by the manufacturer. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.14 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas. Remove and replace concrete that cannot be repaired and patched to Project Engineer's approval.

- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 - 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Project Engineer.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 - 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 - 2. After concrete has cured at least 14 days, correct high areas by grinding.
 - 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 - 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.

5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4-inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 6. Repair defective areas, except random cracks and single holes 1-inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mix as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 7. Repair random cracks and single holes 1-inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Project Engineer's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Project Engineer's approval.

3.15 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement according to requirements specified in this Article.
- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mix exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 - a. When frequency of testing will provide fewer than five compressive strength tests for each concrete mix, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each batch of each

- concrete mix. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
 4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F/4.4 deg C and below and when 80 deg F (27 degC) and above, and one test for each composite sample.
 5. Unit Weight: ASTM C 567, one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
 6. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of four standard cylinder specimens for each composite sample.
 - a. Cast and field cure one set of four standard cylinder specimens for each composite sample.
 7. Compressive-Strength Tests: ASTM C 39; test two laboratory-cured specimens at 7 days and two at 28 days.
 - a. Test two field-cured specimens at 7 days and two at 28 days.
 - b. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at age indicated.
- C. When strength of field-cured cylinders is less than 85 percent of companion laboratory cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
- D. Strength of each concrete mix will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
- E. Test results shall be reported in writing to Project Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-and 28-day tests.

- F Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Project Engineer but will not be used as sole basis for approval or rejection of concrete.
- G. Moisture Vapor Emission Test: Standard test method meeting ASTM F-1869.
- H. Alkalinity (pH Level) Testing: Standard test required for floor slabs and all wall and ceiling surfaces to receive painted finishes. Testing of concrete to receive paint finish may be conducted under Painting Section.
- I. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Project Engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by Project Engineer.

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DIVISION 4 - MASONRY
SECTION 04810
UNIT MASONRY ASSEMBLIES

PART 1 - GENERAL

1.01 SUMMARY

- A. Provide all unit masonry assemblies, including, but not limited to, the following items as indicated on the drawings and specified herein:
 - 1. Concrete masonry units.
 - 2. Mortar and grout.
 - 3. Reinforcing steel.
 - 4. Ties and anchors.
 - 5. Miscellaneous masonry accessories.

1.02 DEFINITIONS

- A. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.03 SUBMITTALS

- A. Submit in accordance with SECTION 01300 - SUBMITTALS.
- B. Product Data: For each different masonry unit, strength classification, additive, accessory, and other manufactured product specified.
- C. Reinforcing steel: Certified mill test results or laboratory test results. Indicate bar size, yield strength, ultimate tensile strength, elongation and bend test.
- D. Shop Drawings: Show fabrication and installation details for the following: Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement."
- E. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
- F. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:

1. Each cement product required for mortar and grout, including name of manufacturer, brand, type, and weight slips at time of delivery.
 2. Grout mixes. Include description of type and proportions of ingredients to assure compliance with the compressive strength specified in the drawings.
 3. Each material and grade indicated for reinforcing bars.
 4. Each type and size of anchor, tie, and metal accessory.
- F. Test Reports: Manufacturer's tests shall be in accordance with ASTM C140 for conformance with the requirements of ASTM C90.

1.04 QUALITY ASSURANCE

- A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.
- B. Block plant shall maintain a quality control program to monitor and control block chloride ion content. Soluble chloride ion content should not exceed 0.30 per cent by volume of the cement material in the block, based on ACI 318-14 Table 19.3.2.1.
- C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source or producer for each aggregate.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. Carefully stack and handle masonry units so as to prevent chipping, marring or cracking of corners, edges and faces.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.06 PROJECT CONDITIONS

- A. Protection of Masonry: In rainy locations and conditions, cover tops of columns with waterproof sheeting to repel water.

- B. Do not apply uniform roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry columns.
- C. Stain Prevention: Protect to prevent stain damage to mar final finish or finishing techniques. Prevent grout, mortar, and soil from staining the face of masonry to be left exposed, stained or painted.
- D. Hot-Weather Requirements: Protect unit masonry work when temperature and humidity conditions produce excessive evaporation of water from mortar and grout. Provide artificial shade and wind breaks and use cooled materials as required. Set masonry units within one minute of spreading mortar.

PART 2 – PRODUCTS

2.01 CONCRETE MASONRY UNITS

- A. Concrete Masonry Units: ASTM C-90 and as follows:
 - 1. Unit Compressive Strength: Provide load bearing units with minimum average net area compressive strength of 2,000 psi.
 - 2. Size (Width): Manufactured to 12 inches nominal; 11-5/8 inches actual, within variations in dimensions only as permissible per ASTM C-90:

2.02 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150, Type II. Provide natural color or white cement as required to produce mortar color indicated.
- B. Mortar Cement: Shall be Type "M" conforming to ASTM C270 and have a minimum compressive strength of 2,500 psi at 28 days.
- C. Aggregate for Mortar: ASTM C 144.
- D. Aggregate for Grout: ASTM C 404.
- E. Plasticizer Additive:
 - 1. Powder Type: Proprietary pozzolanic mortar plasticizer.
 - 2. Liquid Type: Proprietary mixture of resins.

- F. Water for use in mixing Mortar and Grout: Potable and complying with ASTM C 94. Clean and free from injurious amounts of oils, acids alkalis, salts, organic materials or other substances that may be deleterious to both mortar and reinforcement.

2.03 REINFORCING STEEL

- A. Steel Reinforcing Bars: ASTM A 615/A 615M, deformed, Grade 60 unless otherwise indicated on the drawings or specified herein.

2.04 MISCELLANEOUS MASONRY ACCESSORIES

- A. Reinforcing Bar Positioners: Commercial plastic or wire units designed to fit into mortar bed joints spanning masonry unit cells with loops for holding reinforcing bars in center of cells. Units formed from steel wire shall be, hot-dip galvanized after fabrication. Commercial plastic units are fabricated for the intended purpose.
1. Provide units with either 2 loops or 4 loops as needed for number of bars indicated.
 2. Other Suitable Devices: Other suitable devices may be used, upon proper submittal to and approval by Engineer.

2.05 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated. Do not use calcium chloride in mortar or grout.
- B. Mortar for Unit Masonry: The proportioning of materials for mortar and grout shall be by volume and done in such manner that the specified proportions can be controlled and accurately maintained. Measure fine aggregate in a damp loose condition. Mix materials in a mechanical batch mixer for at least 3 minutes for mortar and 5 minutes for grout, but do not mix more than 10 minutes. Hand mixing is permitted only for small batches of 3 cubic feet or less.
- C. Grout for Unit Masonry: Sufficient water shall be used to produce a consistency just fluid enough for pouring or pumping without segregation. Grout shall be used and placed in final position within 90 minutes after mixing, but shall in no case be used after initial set has occurred. This time

limitation is permitted to be waived, if the grout is of such slump that it can be placed without addition of water.

1. Grout shall attain not less than 2,500 psi 28-day compressive strength per ASTM C 1019 unless noted otherwise on drawings.
- D. Grout Mixes: Shall conform to ASTM C-476 for grout mixed on-site or ready-mix grout designed by ready-mix suppliers.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance.
 2. Verify that floor levels, footing levels or foundations are within tolerances specified.
 3. Verify that reinforcing dowels are properly placed.
 4. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

- A. General: All masonry units shall be clean and handled to protect and minimize chipping, spalling and cracking. All bed on which masonry is to be laid shall be clean.
- B. Masonry units shall not be wetted prior to use. Units which have become wet shall be allowed to dry thoroughly before laying. If water is splashed on the block and a color difference does not occur (from the water) then the block units are too wet to be laid.
- C. Cut masonry units with motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide a continuous pattern and to fit adjoining construction. Where possible, use full-size units without cutting. Allow units cut with water-cooled saws to dry before placing, unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

- D. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.

3.03 CONSTRUCTION TOLERANCES

- A. Comply with the tolerances in the national concrete masonry association Specification for Masonry Structures TMS 602 as applicable to climate indigenous to Hawaii and as noted.

3.04 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. When foundation is at specified levels, lay first course masonry units in a mortar bed not exceeding 3/4-inch thick. Bed webs of adjoining cells that contain reinforcement in mortar to prevent escape of grout.
- C. Bond Pattern for Exposed Masonry: Lay exposed masonry in the bond pattern indicated on the drawings.
- D. Stopping and Resuming Work: Clean exposed surfaces of set masonry and remove loose masonry units and mortar before laying fresh masonry.
- E. Fill cores in hollow concrete masonry units with grout 24 inches under bearing plates, beams, and similar items, unless otherwise indicated or directed.

3.05 MORTAR BEDDING AND JOINTING

- A. Lay hollow masonry units as follows:
 1. With full mortar coverage on horizontal and vertical face shells.
 2. Bed webs in mortar in starting course on footings and in all courses of columns and where adjacent to cells or cavities to be filled with grout.
- B. Lay horizontal-cell units with full bed joints, unless otherwise indicated. Keep drainage channels, if any, free of mortar. Form head joints with sufficient mortar so excess will be squeezed out as units are placed in position. Butter both sides of units to be placed, or butter one side of unit already in place and one side of unit to be placed.

- C. Maintain joint thicknesses indicated, except for minor variations required to maintain bond alignment. If not indicated, lay walls with 1/4- to 3/8-inch thick joints.
- D. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than the joint thickness, unless otherwise indicated.

3.06 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores to support reinforced masonry elements during construction.
 - 1. Construct formwork to conform to shape, line, and dimensions shown. Make it tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
 - 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements TMS 602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist grout pressure.
Comply with requirements of TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.

3.07 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2 applicable to type of stain on exposed surfaces. Obtain Engineer's approval of sample cleaning before proceeding with cleaning of masonry.

END OF SECTION

SECTION 05500
MISCELLANEOUS METALS

PART 1 - GENERAL

1.01 SUMMARY

A. SECTION INCLUDES:

1. All metal fabrications and other miscellaneous metal items together with related accessory items and fasteners, including:
 - a. Steel ladders.
 - b. Hatches and covers.
 - c. Chain closures.
 - d. Gratings.
 - e. Grating support angles.
 - f. Steel channel and angle door frames.
 - g. Miscellaneous hot rolled structural members.
 - h. All other metal fabrications and miscellaneous metal not covered under other sections.
2. This Section is applicable to deferred submittal items as indicated within the Contract Documents.

1.02 REFERENCES

A. AMERICAN NATIONAL STANDARDS INSTITUTE:

1. B18.23.1 Beveled Washers

B. ASTM INTERNATIONAL (ASTM):

1. A36 Specification for Carbon Structural Steel
2. A53 Specification for Pipe, Steel, Black and Hot-Dipped Zinc-Coated Welded and Seamless
3. A123 Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
4. A153 Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
5. A193 Alloy-Steel and Stainless Bolting Materials for High Temperature or High-Pressure Service and Other Special Purpose Applications
6. A194 Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
7. A276 Stainless Steel Bars and Shapes
8. A283 Specification for Low and Intermediate Tensile Strength Carbon Steel Plates

- 9. A307 Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
- 10. A320 Alloy-Steel and Stainless-Steel Bolting or Low Temperature Service
- 11. A370 Test Methods and Definitions for Mechanical Testing of Steel Products
- 12. A384 Safeguarding Against Warpage and Distortion Hot-Dip Galvanizing of Steel Assemblies
- 13. A500 Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
- 14. A501 Specifications for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
- 15. A653 Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Gavannealed) by the Hot-Dip Process
- 16. A786 Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy and Alloy Steel Floor Plates
- 17. A793 Specification for Rolled Floor Plate, Stainless Steel
- 18. B209 Aluminum and Aluminum-Alloy Sheet and Plate
- 19. B210 Aluminum and Aluminum-Alloy Drawn Seamless Tubes
- 20. B221 Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire
- 21. B241 Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube
- 22. B308 Aluminum Alloy 6061-T6 Standard Structural Profiles
- 23. B632 Specification for Aluminum-Alloy Rolled Tread Plate
- 24. B429 Aluminum-Alloy Extruded Structural Pipe and Tube
- 25. C595 Specification for Blended Hydraulic Cement
- 26. F436 Hardened Steel Washers
- 27. F593 Stainless Steel Bolts, Hex Cap Screws, and Stubs
- 28. F594 Stainless Steel Nuts
- 29. F844 Specification for Washers, Steel, Plain (Flat), Unhardened for General Use
- 30. F2329 Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners

C. PUBLICATIONS OF THE NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM):

- 1. "Metal Product Outline; Division 5 Metal"
- 2. "Metal Finishes Manual"
- 3. "Pipe Railing Manual"
- 4. "Metal Bar Grating Manual"

- D. The Society for Protective Coatings (SSPC), Volume 2. Standards for Surface Preparation are specified by SSPC followed by SP and a number indicating the specified type of surface preparation.
- E. Aluminum Design Manual, Part 1 – A Specification and Guidelines for Aluminum Structures, Current Edition.
- F. Minimum Design Loads and Associated Criteria for Buildings and Other Structures, American Society of Civil Engineers (ASCE/SEI 7-16).
- G. Hawaii State Building Code (HSBC), based on the 2018 International Building Code. Effective Date: April 20, 2021. Errata and Addenda: August 17, 2021.
- H. International Building Code, by the International Code Council, Inc., 2018.
- I. International Code Council (ICC).

1.03 SUBMITTALS

- A. Product Data: Fully describe every product proposed for use.
- B. SHOP DRAWINGS:
 1. Show dimensions, finishes, joining, attachments, inserts, and relationship of work to adjoining construction.
 2. Indicate all shop and erection details including cuts, copes, connections, holes, threaded fasteners and welds. Indicate welds using AWS "Welding Symbols."
 3. Show field measured dimensions of this and adjacent work and location of inserts on fabrication drawings.
 4. Submit a full floor plan layout and details for all gratings and grating support framing.
 5. Submit a full floor plan layout and details for all floor plates and floor plate support frames.
 6. Fabrication drawings showing layouts with dimensions consistent with the Drawings, connections to structural system, and anchoring details. Anchoring details shall include the required bolt diameter, embed, spacing, and edge distances consistent with the calculations.
 - a. Erection and installation drawings indicating thickness, type, grade, material strength, class of metal, coating system and dimensions.
- C. CALCULATIONS:
 1. Where calculations are required as part of a deferred submittal, the following requirements shall be met: Complete calculations, details, and complete reference drawings that are required to be submitted as part of a deferred submittal and as defined in the IBC and the Contract Documents, shall be prepared, stamped, signed, and furnished by a

Professional Civil or Structural Engineer licensed to practice in the State of Hawaii.

2. Calculations shall be comprehensible and complete. When evaluating the structural strengths, indicate stress for comparing with strengths or show the demand versus capacity ratio in the structural elements. Evaluating the results by stating "Okay by Inspection" is not acceptable. When spreadsheets are used, clearly reference equations and formulas presented in submittal calculations.
3. Reference drawings shall include plans, sections, details and equipment information as necessary for seismic calculations. Indicate the location of the equipment on plan which is necessary for load calculations.
4. Submittals shall be returned without review if:
 - a. Submittals include only calculations without reference drawings.
 - b. Calculations have no sheet numbers or sheets are missing.
 - c. Calculations or reference drawings are illegible.
 - d. Calculations are made based on wrong information, assumptions or design parameters.
 - e. Information in reference drawings is insufficient for calculations or review
5. The calculations and details shall demonstrate a complete vertical and lateral load path and shall clearly indicate all forces imposed on the supporting structure.
6. Anchor Bolt Calculations and Details:
 - a. Anchor bolt calculations shall clearly show that the capacity of the anchor and the capacity of the concrete that the anchor is embedded in are adequate to resist all applicable load combinations, including wind and seismic loads.
 - b. The design of anchors resisting seismic forces shall satisfy the ductility requirements stated in the IBC, ASCE 7, and ACI 318 14.
 - c. Reduction factors associated with edge distance, embedment length, grout and base plate thickness, and bolt spacing shall be considered in the design and clearly indicated on the submittal drawings.
 - d. Anchor bolts shall be designed for bending due to eccentricity where raised grout pads will be installed for leveling.
 - e. Reference Specification Section 01190 for information not indicated in this section.

- D. Welding procedures and welder certificates and qualifications.
- E. U-Channel Concrete Inserts: Manufacturer's product description and allowable load tables.
- F. Passivation method for stainless steel fabrications.

1.04 QUALITY ASSURANCE

A. CONTRACTOR'S QUALIFICATIONS:

1. Welding procedures, welders, and welding operations shall be qualified for the type of work required in accordance with AWS Standard Qualification Procedures.
- B. Regulatory Requirements: Comply with the following codes and reference standards unless higher standards are specified, shown or required by applicable codes:
 1. "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings," American Institute of Steel Construction (AISC), latest edition.
 2. Structural Welding Code of the American Welding Society, AWS D1.1, latest edition.
 3. Hawaii State Building Code (HSBC).
 4. Federal Americans with Disabilities Act (ADA).

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver anchorage devices that will be embedded in the work of other trades in sufficient time to permit their timely installation. Provide proper setting drawings, templates and directions for installation.
- B. Store materials above ground on platforms, skids or other supports. Store all fasteners and welding electrodes in a weathertight and dry location until ready for use. Store packaged materials in their original labeled containers.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

A. STANDARD STRUCTURAL STEEL SHAPES:

1. Bars, Plates, Shapes (not W shapes): ASTM A36
2. W Shapes, Structural Steel: ASTM A992
3. Steel Tubing (welded or seamless): ASTM A500, Grade B or ASTM A501 (hot formed)
4. Steel Pipe (seamless): ASTM A53, Type E or S, Grade B
5. Architectural Steel Items: ASTM A283, Grade A
6. Checkered Plates: ASTM A786
7. Iron Castings: ASTM A48
8. Eyebolts: ASTM A489
9. Anchors, Bolts and Nuts:
 - a. Headed Anchor Studs: ASTM A108

- b. Threaded Rods: Type 316 Stainless Steel or as noted on the Drawings or Submittal
- c. Carbon Steel Bolts: ASTM A307, Grade A
- d. High Strength Bolts: ASTM A325 (Type 1)
- e. Nuts: ASTM A563
- f. Washers: ASTM F436
- g. Beveled Washers: ANSI B18.23.1

B. ALUMINUM:

- 1. Sheets and Plates: ASTM B209, Alloy 6061-T6
- 2. Bars, Flats, Similar Items: ASTM B211 or B221, Type 6061-T6
- 3. Shapes: ASTM B308, Alloy 6061-T6
- 4. Round Tubes and Pipe: ASTM B241, Alloy 6061-T6 or 6063-T5 with anodized finish
- 5. Square and Rectangular Tubes: ASTM B221, Alloy 6063-T6
- 6. Bolts: ASTM F593, Type 304 or 316
- 7. Nuts and Washers: ASTM F594, Type 304 or 316

C. STAINLESS STEEL:

- 1. Sheets and Plates: ASTM A240, Type 316 or 316
- 2. Shapes, Bars, Similar Items: ASTM A276, Type 304 or 316
- 3. Pipe: ASTM A313, Type 304 or 316
- 4. Headed Anchor Stud: ASTM A276, Type 304 or 316
- 5. Bolts: ASTM F593, Type 304 or 316
- 6. Nuts and Washers: ASTM F594, Type 304 or 316

D. POST-INSTALLED ANCHORS:

- 1. General:
 - a. Refer to Section 01190 for structural design requirements.
 - b. All post-installed anchors shall be stainless steel, unless otherwise noted on the Drawing.
 - c. Unless otherwise noted or specified on the Drawings, all anchorage shall be a deferred submittal. Reference Section 01190 for the structural design requirements and submittal requirements for anchorage calculations.
- 2. Adhesive Anchors:
 - a. Adhesive anchors are required or drilled anchors for outdoor installations, in submerged, wet, splash, and corrosive conditions.
 - b. Provide a satisfactory evaluation report by ICC-ES or IAPMO-UES for adhesive anchors.
 - c. Do not use adhesive anchors for loads in tension or withdrawal, or for loads subject to vibration or fire.
 - d. Epoxy anchors shall not be permitted in areas where the concrete temperature is in excess of the limiting temperature recommended

- by the manufacturer. Minimum substrate temperatures shall be maintained during the full curing period as required by the manufacturer.
- e. Acceptable Adhesives:
- 1) HIT-RE 500 V3 Adhesive by Hilti, Inc. or,
 - 2) SET-XP Epoxy Adhesive or SET-3G Epoxy Adhesive by Simpson Strong-Tie Company, Inc. or,
 - 3) Pure110+ Epoxy Adhesive by DEWALT or,
 - 4) Approved Equal. No substitutions will be considered unless accompanied with a relative and current ICC-ES or IAPMO-UES report verifying the strength and material equivalency in cracked concrete.
3. Mechanical Anchors:
- a. Provide a satisfactory evaluation report by ICC-ES or IAPMO-UES for mechanical anchors.
 - b. Do not use post-installed for loads in tension or withdrawal or for loads subject to vibration.
 - c. Lead caulking anchors are not permitted.
 - d. Non-embedded buried or submerged anchors shall be fabricated from Type 316 stainless steel.
 - 1) Acceptable Mechanical Anchors:
 - a) Kwik Bolt-TZ, Kwik Bolt-TZ 2 or 3, by Hilti, Inc. or,
 - b) Strong-Bolt 2 by Simpson Strong-Tie Company, Inc. or,
 - c) Power-Stud+SD1 or SD2 by DEWALT or,
4. Approved Equal. No substitutions will be considered unless accompanied with a relative and current ICC-ES or IAPMO-UES report verifying the strength and material equivalency in cracked concrete.

2.02 GALVANIZING

- A. Hot-Dip Galvanizing: Shall conform to ASTM A123 and A153, as applicable. Hot-dip galvanized coating applicator shall be a member of the American Galvanizing Association.
1. Zinc-used for galvanizing shall conform to ASTM AB6, and shall be at least equal to the grade designated as Prime Western.
 2. The maximum amount of aluminum added to a galvanizing bath shall not exceed 0.01.
- B. Exterior and Interior Ferrous Metal Work: Hot-dip galvanize.
- C. Sheet Steel, Plain or Shaped: In accordance with ASTM A653, G90.
- D. Steel Hardware, Nuts, Bolts, Washers, Anchors, Threaded Rods: Hot-dip galvanize all steel hardware, nuts, bolts, washers, anchors, and threaded rods in accordance with ASTM A153 or F2329. Size thread clearance to allow

for galvanized coating; rerun threads after galvanizing, if required, to assure a smooth fit.

2.03 GALVANIZING REPAIR

- A. Repair damaged galvanizing by heated repair method. Repair materials: ReGalv by Rotometals, Inc., San Francisco, CA; or equal.
- B. Repair damaged zinc-coated surfaces with galvanizing repair method and paint conforming to ASTM A780, unless otherwise specified.
- C. Safeguard against warpage and distortion during galvanizing of steel in accordance with ASTM A384. Straighten items after galvanizing so that they are straight, free of racking and distortion.

2.04 SHOP PRIMING

- A. Refer to Section 09900 for surface preparation, pretreatment, primers, and application techniques.
- B. Apply one shop coat of rust inhibiting primer to all steel fabrications not scheduled to be galvanized.
 - 1. Apply two coats of primer to surfaces not in contact but inaccessible after assembly.

2.05 ISOLATION COATINGS

- A. Coat aluminum in contact with other metals with aluminum pigmented asphalt paint or two coats of a high build polyamide epoxy paint, Tnemec 66 or equal, with a total thickness of system DF = 8.0 mils, minimum.
- B. Coat aluminum in contact with concrete, masonry or plaster bituminous mastic or zinc chromate coating, Tnemec 46-465 or equal, with a total thickness of system DFT = 8.0 mils, minimum.
- C. Provide neoprene or phenolic washers and isolation bolt sleeves or insulating compound at all stainless-steel fasteners to aluminum interfaces. Isolation washers shall be capped under a stainless-steel washer. Insulating compounds shall be Tef-Gel by Ultra Safety Systems Company, Lanocote by Forespar, or equal.

2.06 FABRICATIONS

A. METAL LADDERS:

- 1. As shown on the Drawings.

2. Rails: 2-½-inch x 3/8-inch flat bar drilled or punched for insertion of rungs.
3. Provide Mcbac surfaces solid steel rungs by IKG Borden or equal.
4. Rungs: 1-inch-diameter solid bar inserted into holes drilled in rails and welded on the outside. Space rungs equal distance apart. Coat rungs with an epoxy base paint containing aluminum oxide grit by Wooster "Safe-Stride" anti-slip paint; or equal.
5. Provide brackets, welded to rails, spaced 8 feet on centers maximum for attachment to concrete or masonry with two ¾ inch-diameter drilled anchor bolts at each connection.
6. Provide a retractable ladder extension where ladder does not extend above the highest surface served: Bilco "Ladder Up," equivalent by Saf-T-Climb; or equal.

B. HATCHES AND COVERS:

1. Where access hatches are mounted on slabs (including top slabs) or on a concrete curb, the hatch shall be flush type as indicated.
2. Hatches shall be fabricated from aluminum 5086 H34, 6063-T5, or 6061 T6, unless otherwise indicated on the Drawings.
3. Hatch and cover hardware shall be fabricated from Type 316 stainless steel and shall be gutter type.
4. Configuration:
 - a. Hatch opening sizes, number and swing direction of door leaves, and locations shall be as indicated.
 - b. Indicated sizes are for the clear opening.
 - c. Where the number of leaves is not indicated, openings larger than 42 inches in either direction shall be provided with double-leaf doors.
 - d. Unless indicated otherwise, ladder hatches shall be a minimum of 30 inches wide by 36 inches long, with the ladder centered on the shorter dimension and the door hinge opposite the ladder.
5. Door leaves shall be fabricated from a minimum of ¼-inch thick checkered-pattern plate.
6. Channel frames shall be fabricated from a minimum ¼-inch material with an anchor flange around the perimeter.
7. Hatches shall be provided with an automatic hold-open arm with release handle.
8. Hatches shall be designed for easy opening from both inside and outside.
9. Hatches shall be designed to be water-tight and shall be equipped with a joint gutter, a moat-type edge drain, and drain piping of the length and size necessary to remove the drain water from all dry spaces accessed by the hatch.
10. A minimum 1-1/2-inch-diameter drain connection shall be provided, located by the manufacturer.

11. Hatches shall be provided with a recessed hasp for a padlock covered by a hinged lid that is flush with the surface.
12. Hatches shall be Bilco Type J-AL or, Babcock-Davis.

C. CHANNEL AND ANGLE DOOR FRAMES:

1. Construct channel and angle door frames using hot-rolled steel channels and bars or steel angles and bars. Provide single piece head members and jamb members without splices or joints.
2. Fabricate anchors from steel bars or plate, welded to frames. DO NOT USE welding studs (Nelson studs) to anchor members to concrete.
3. Mortise, reinforce, drill and tap frames to receive finish hardware. Coordinate detailing of frames with finish hardware requirements prior to fabrication of frames.
4. Hot-dip galvanize all channel and angle door frames after fabrication. Retap screw holes after galvanizing. Miter weld and grind smooth door frame corners. Fabricate door frames too large to permit galvanizing as a single unit as separate head and jamb members with concealed bolted connections at top corners.
5. Deliver door frames as shop-fabricated single-piece units when possible.

D. Chain Closure: Provide chain closures and related fittings made from 5/16-inch 316 stainless steel, with oblong links. Provide three chains 4 inches longer than the anchorage spacing for each guarded area. Mount chains as shown. Provide each chain with boat type snap hooks at each end. Provide eye bolts with 3/8-inch-shank diameter and with 7/8-inch eye for attachment of chains at each anchorage. Provide fittings of the same material and finish as the chain.

E. GRATING AND FLOOR PLATE SUPPORT FRAMES:

1. Material: Galvanized steel or as noted on the Drawings.
2. Provide grating support angles for all gratings and floor plates. Fabricate grating support angles in complete, closed frames that will lie completely flat in a true plane. Install support frames so they will support the grating and floor plates with even, uniform, non-rattling bearing. Set frames so that the surface of the grating and floor plates are flush with the adjacent floor or surface.
3. Design and fabricate support frames as required to prevent twisting due to any large ratio of length to width. Restrict the length of each closed section of long narrow support frames to 10 feet maximum.
4. Hot-dip galvanize support frames after fabrication. Grind welds smooth on the bearing surface before galvanizing.

F. GRATING:

1. General Grating Requirements: Provide gratings that comply with requirements in the NAAMM Metal Bar Grating Manual.
 - a. Field measure installed grating frames before fabricating gratings.
 - b. Provide grating panels that are absolutely flat, correctly sized, and fabricated to lie in their frames with uniform, non-rattling bearing on all supporting surfaces.
 - c. Fabricate with top surface of all bars flush. Install grating flush with adjacent concrete or other walking surfaces.
 - d. Provide punch serrated non-slip upper surface on grating in wet areas and areas noted to have a nonslip surface.
 - e. Band: Ends of all fixed and removable grating section. Weld banding bars of the same thickness and the same depth as the main bearing bars to the ends of all bearing and cross bars. Weld the banding bars flush with the bearing bars at each panel corner and grind the weld smooth and flush. Round all edges and corners to 1/8-inch radius.
 - f. Band all shop and field cutouts and openings. Weld the banding bars to all cut bearing and cross bars.
 - g. Leave "split" openings in the gratings when required for the passage of pipes, valve stems or other devices.
 - h. Provide "fixed" grating for all operating grating platforms. Bolt "fixed" grating to support members with saddle clips and stud bolts welded to support members.
 - i. Where required for access or where noted, provide removable grating sections sized to limit the weight of any one section to 90 pounds.
 - j. Bolt removable sections in place by the same method used for fixed grating. Mark removable sections by painting the banding bars red after fabrication.
2. Steel grating:
 - a. Manufacturer: Grating Pacific; IKG industries; or equal.
 - b. Welded steel grating: Hot-dip galvanized steel grating.
 - c. Main bars: Not less than 1-1/4-inch high and 3/16-inch in thickness and spaced 1-3/16 inches on center. Cross bars: Spaced not more than 4 inches on center.
 - d. Size steel grating and support members rated for 300 pounds per square foot superimposed load with a grating deflection not to exceed 1/4-inch.
3. Aluminum grating:
 - a. Manufacturer: Grating Pacific; Ohio Gratings; or equal.
 - b. Aluminum Alloy 6063-T6 rectangular bar gratings with a serrated top surface, pressure locked, 1-3/16 x 4-inch bar spacing unless noted otherwise.

- c. Furnish gratings with bar sizes and intermediate supports rated for 300 pounds per square-foot superimposed load with a grating deflection not to exceed $\frac{1}{4}$ inch.
- d. Anchor aluminum grating in place with stainless steel bolts and saddle clips.

2.07 ATTACHMENTS

- A. Metal Anchors: Provide metal anchors and fasteners required to secure all frames and other items rigidly in place and detailed for installation into concrete forms prior to placing concrete.
- B. Anchor Bolts and Anchorages to Concrete and Masonry: Full diameter stainless steel unless otherwise shown. Use of welding studs (Nelson studs) is prohibited.

PART 3 - EXECUTION

3.01 ERCTION TOLERANCES

- A. Conform to straight plumb and horizontal lines which also form a true flat plane to within 1/8-inch in 2 feet and $\frac{1}{4}$ -inch in 10 feet and $\frac{1}{2}$ maximum overall.
- B. Curved surfaces shall conform to a true arc of a circle to within 1/8-inch in 12 inches and $\frac{1}{4}$ -inch maximum overall.

3.02 INSTALLATION GENERAL

- A. Fabricate and pre-fit metal work in the shop, in transportable components ready for field erection.
- B. Make proper allowance for expansion and contraction of the metals and of the materials to which they are fastened.
- C. Where metal is fastened to concrete, make the connection by means of sleeves and fastenings embedded in concrete or by expansion shield anchor bolts or wedge anchor bolts. Wood plugs, plastic plugs or powder driven studs are not acceptable.
- D. Construct steel work in accordance with AISC Standard practices to withstand the forces normally applied and in compliance with IBC and OSHA requirements.
- E. Grind welds smooth on all metal work exposed to view. Provide work that has:

1. Surfaces that are flat, straight, square, plumb and level.
 2. Smooth curves, free of flat spots, and of uniform radius or, if intended to be of changing radius, follow a flowing fair curve.
 3. Make transitions between curved and straight portions of work at tangent points to achieve smooth and free flowing lines and surfaces without flat spots or abrupt changes in direction.
- F. Provide 1/8-inch radius corners and edges on all exposed work.
- G. Perform all welding in accordance with AWS Code D1.1. Employ methods and techniques to achieve strength and good appearance.
- H. Field Assembly: Set members to lines and elevations indicated. Align and adjust members before making permanent connections.
- I. Galvanized Metal Repair: Repair damaged galvanized metal by the heated substrate method as specified in paragraph 2.03.
- J. Touch-up Painting (Ferrous Metals): After field assembly, clean all bare metal and all abrasions to shop coat, and spot paint with same primer used in the shop.

3.03 STEEL LADDERS

- A. Install ladders with stainless steel expansion anchor bolts.
- B. Locate first rung same distance above surface below it as space between other rungs.

3.04 GRATINGS AND FLOOR PLATES

- A. Install support frames so that gratings and floor plates have continuous support and so gratings and floor plates will sit in their frames without rattling or rocking in any direction including across diagonal corners.

3.05 MISCELLANEOUS

- A. Furnish the following for field installation:
 1. Custom fabricated steel connectors for wood beams and other rough carpentry work.
 2. Door frames made of structural steel shapes for installation in the concrete pour. Provide all anchors and connectors.
 3. Miscellaneous metal work not specified in other sections.

3.06 REPAIRS

- A. Repair or replace all defective work including:

1. Unsightly welds.
2. Discontinuous welds.
3. Uneven connections.
4. Variations exceeding specified tolerances.
5. Kinks, bends.
6. Other defects affecting the quality, strength, utility and appearance of the work.

3.07 CLEANING

- A. Wash thoroughly using clean water and detergent.
- B. Do not use acid solutions, steel wool or other abrasives.
- C. Remove stubborn grease stains with mineral spirits.

END OF SECTION

DIVISION 6 – WOODS AND PLASTICS

SECTION 06100

ROUGH CARPENTRY

PART 1 - GENERAL

1.01 SUMMARY

- A. Provide all rough carpentry, including, but not limited to, the following items as indicated on the drawings and specified herein:
 - 1. Framing lumber.
 - 2. Structural members.
 - 3. Plywood.
 - 4. Miscellaneous materials.
 - 5. Moisture barrier.
 - 6. Preservative treatment of all lumber unless specified or noted otherwise.

1.02 SUBMITTALS

- A. Submit in accordance with SECTION 01300 - SUBMITTALS.
- B. Manufacturer's Data: Submit manufacturer's technical product information on all products to be used, including recommendations and restrictions on wood species and uses.
- C. Manufacturer's Instructions: Submit manufacturer's written instructions for handling, disposing, and field treating treated lumber.
- D. Certificate of Treatment: Submit a certificate of treatment showing compliance with these specifications, both as to kiln drying and type of treatment performed, including dip treatment.
- E. Certification: The Contractor shall submit a written certification that all wood used and left in place on this job was treated in accordance with these specifications and that all cuts and penetrations made subsequent to the treatment were coated with preservatives in compliance with these specifications.
- F. Safety Data Sheets (SDS): Submit SDS for each material as applicable.
- G. Treatment Schedule: Prior to treatment, submit a complete list of all wood products, including each species if treated with different preservative material and the treatment material proposed for use.

1.03 QUALITY ASSURANCE

- A. Grading Marks: Factory mark each piece of lumber with type, grade, mill, and grading agency identification. Certificate of inspection and grading by a recognized agency may be submitted with each shipment in lieu of factory marking, at Contractor's option.
- B. Preservatives containing arsenic such as chromated copper arsenate (CCA) and ammoniacal copper zinc arsenate (ACZA) shall not be used.
- C. Perma-Clear 65 or other zinc naphthenate products shall not be used.
- D. Comply with all State OSHA and pollution control regulations of the State of Hawaii and EPA.
- E. Do not use treatments containing EPA banned chemicals.
- F. Materials shall be specifically recommended by the manufacturer for species of wood, use intended, and exposure indicated.
- G. Structural lumber shall be treated in accordance with AWPA Standard U1, "Use Category System: User Specification for Treated Wood", (UC1 thru UC4B) in accordance with current adopted ICC IBC as amended.
- H. Labeling: Permanent ink stamp or durable tag permanently fastened as stipulated in current adopted ICC IBC as amended. Fire retardant treated materials shall have UL labels.
- I. Do not use oil-borne preservatives where food contact is possible.
- J. Products with chlorpyrifos shall not be used without prior written approval by the Project Engineer.

1.04 PRODUCT HANDLING

- A. Delivery and Storage: Keep materials dry at all times. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber and provide air circulation within stacks.

1.05 JOB CONDITIONS

- A. Coordination: Fit carpentry work to other work; scribe and cope as required for accurate fit. Correlate location of furring, rough bucks, blocking, and similar supports to allow proper attachment of other work

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Lumber, General: Factory-mark each piece of lumber with type, grade, mill, and grading agency, except omit marking from surfaces to be exposed with transparent finish or without finish. Nominal sizes are

indicated, except as shown by detail dimensions. Provide actual sizes as required by PS 20, for moisture content specified for each use.

1. Provide dressed lumber, S4S, unless otherwise indicated.
 2. Provide seasoned lumber with 15% maximum moisture content at time of dressing.
- B. Framing Lumber: Unless otherwise indicated on the structural drawings, provide the following:
1. Light Framing Lumber: 2-inches through 4-inches thick, less than 6-inches wide, such as nailers, plates, blocking, rough bucks, furring, etc., provide No. 2 Grade, Douglas Fir/Larch.
 2. For Structural Framing: 2-inches, provide No. 2 Grade, 4-inches thick and wider, such as beams, provide No. 1 Grade, Douglas Fir/Larch, (WCLB or WWPA).
- C. Structural Members: Unless otherwise indicated on the structural drawings, provide the following: For beams and all other structural members, provide No. 1 Grade, Douglas Fir/Larch.
- D. Plywood: Unless otherwise indicated on the drawings, provide the following:
1. Softwood Plywood: Comply with U.S. Product Standard PS 1 for softwood plywood, Group 1, Douglas Fir, Exterior Grade only, roof sheathing.
- E. Miscellaneous Materials - Fasteners and Anchorages: Provide size, type, material, and finish as recommended by applicable standards, complying with applicable Federal Specifications and ANSI for nails, staples, screws, bolts, nuts, washers, and anchoring devices. Provide metal hangers and framing anchors of the size and type recommended by the manufacturer for each use, including recommended nails. Provide all fasteners and anchorages with a hot-dip zinc coating, ASTM A 153.
- F. Moisture Barrier: ASTM D 226, T Type II, No. 30, asbestos free, asphalt saturated roofing felt as required to separate wood from concrete and masonry surfaces and as required.

2.02 WOOD TREATMENT

- A. Wood treated with oil-borne preservatives shall be kiln-dried before treatment to an average moisture content of 12 percent to 15 percent per AWPA standards unless specified otherwise.
- B. Wood treated with water-borne preservatives (with the exception of SBX treated wood) shall be air dried or kiln-dried before treatment to an average moisture content of 28 percent or less per AWPA standards.

Wood having a moisture content higher than 28 percent is acceptable when treating with SBX materials.

- C. Wood shall be treated as noted below.
- D. Lumber shall be milled to finish size and shape prior to treating, and it shall be treated before assembly.
- E. Water-Borne Preservatives: Water-Borne Preservatives shall be Preserve ACQ, Preserve Plus ACQ, Wolman E CBA, Hi-Bor SBX, and Timber Saver PT SBX, or pre-approved equal, except as stipulated otherwise in accordance with American Wood Preservers Association (AWPA) Standard P5 - "Standards for Waterborne Preservatives", and permitted by EPA. Preservatives shall be EPA registered. (Hawaii use only treatment is not acceptable).
 - 1. Treatment for ACQ and CBA treated wood shall be as recommended by the manufacturer. Preservatives shall be EPA registered.
 - 2. Water-Borne Preservatives used to coat end cuts and penetrations in SBX treated wood shall be Clear-Bor F.T. or an equivalent solution of 10 percent inorganic boron. The end coating solution must be approved and labeled by the Environmental Protection Agency and must be accepted by the State of Hawaii, Department of Agriculture, Pesticides Branch, for this purpose.

PART 3 – EXECUTIONS

3.01 WOOD PRESERVATION WITH WATER-BORNE PRESERVATIVES

- A. Store the material out of contact with the ground in such manner and location as to minimize deterioration.
- B. Unless otherwise stipulated, all lumber shall be pressure treated.
- C. Lumber shall be treated with ACQ and CBA materials as specified and in accordance with American Wood Preservers Association (AWPA) Standards C2 - "Lumber, Timbers, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Process", and C15 - "Wood for Commercial - Residential Construction", or SBX material, using the full cell pressure method in conformance with AWPA Standard C1 - "All Timber Products - Preservative Treatment by Pressure Processes", or C31, "Lumber Used Out of Contact with the Ground and Continuously Protected from Liquid Water - Treatment by Pressure Processes". Lumber treated with SBX shall attain the following penetration and retention requirements:
 - 1. Lumber:
 - a. Penetration Requirement for Lumber Under 5-inch Nominal Thickness: 0.40-inch in heartwood and 90 percent in sapwood.

- b. Penetration Requirement for Lumber 5-inch Nominal Thickness and Over: 0.50-inch in heartwood and 90 percent in sapwood.
 - c. Retention requirement for lumber shall be a minimum of 1.50 percent weight/weight or 0.42 pound per cubic foot in an assay zone of 0.0 - 0.6 inch for lumber under 5-inches nominal thickness and 0.0 - 0.75 inch for lumber over 5-inches in nominal thickness.
2. Lumber 2-inches or less in thickness shall be dried to a moisture content of 19 percent or less after treatment.

3.02 INSTALLATION

- A. General: Discard units of material with defects which might impair quality of work, and units which are too small to use in fabricating work with minimum joints or optimum joint arrangement.
 1. Set carpentry work accurately to required levels and lines, with members plumb and true and accurately cut and fitted.
 2. Securely attach carpentry work to substrate by anchoring and fastening as shown, or if not shown, as required by recognized standards. Countersink nail heads on exposed carpentry work and fill holes.
 3. Use common wire nails, except as otherwise indicated. Select fasteners of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting of wood; predrill as required.
- B. Wood Framing, General:
 1. Provide framing members of sizes and on spacings wherever shown, and frame openings as shown, or if not shown, comply with recommendations of "Manual for House Framing" of National Forest Products Association. Do not splice structural members between supports.
 2. Anchor and nail as shown, or where not shown, as required and to comply with the current International Building Code.
 3. Provide moisture barrier below all wood plates resting on concrete or masonry.
- C. Wood Nailers, Plates, Blocking, Rough Bucks, Furring, etc.: Provide wherever shown and where required for attachment of other work. Form to shapes and cuts as required for true line and level of work to be attached. Coordinate location with other work involved. Attach to substrates as

- required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise shown.
- D. Moisture Barrier: Apply to separate wood from concrete and masonry surfaces.
 - E. Wherever it is necessary to end cut or penetrate into (such as by drilling or notching) treated wood on the job, all such cuts and penetrations shall be treated in accordance with AWPA Standard M4, "Care of Preservative Treated Wood Products", or in accordance with the approved preservative manufacturer's ICC Evaluation Services report requirements, using 2 heavy brush coats of a treating solution as recommended by the manufacturer. Where allowed by preservative manufacturer, spray cut ends and bored holes with "Hudson Bay" type sprayer, 2 coats. Exception, cuts and penetrations made in SBX treated wood 2-inches or less in nominal thickness need not be field treated.
 - F. Workers, in the field or in applicable millwork shops, shall read and follow all instructions and recommendations of the preservative treatment manufacturer and wood treatment applicator.

3.03 CLEAN-UP

- A. Dispose of treated wood in a sanitary landfill or other authorized disposal area. Do not burn treated wood.

END OF SECTION

SECTION 06176
METAL-PLATE-CONNECTED WOOD TRUSSES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Wood roof trusses.
 - 2. Wood truss bracing.
 - 3. Metal truss accessories.

- B. Related Requirements:

1. SECTION 06100 - ROUGH CARPENTRY.

1.02 DEFINITIONS

- A. Metal-Plate-Connected Wood Trusses: Planar structural units consisting of metal-plate-connected members fabricated from dimension lumber and cut and assembled before delivery to Project site.

1.03 SUBMITTALS

- A. Submit in accordance with SECTION 01300 - SUBMITTALS.
- B. Shop Drawings: Show fabrication and installation details for trusses.
 - 1. Show location, pitch, span, camber, configuration, and spacing for each type of truss required.
 - 2. Indicate sizes, stress grades, and species of lumber.
 - 3. Indicate locations, sizes, and materials for permanent bracing required to prevent buckling of individual truss members due to design loads.
 - 4. Indicate type, size, material, finish, design values, orientation, and location of metal connector plates.
 - 5. Show splice details and bearing details.
- C. Delegated-Design Submittal: For metal-plate-connected wood trusses indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified Structural Engineer licensed to practice in the State of Hawaii responsible for their preparation.

1.04 QUALITY ASSURANCE

- A. Metal Connector-Plate Manufacturer Qualifications: A manufacturer that is a member of TPI and that complies with quality-control procedures in TPI 1 for manufacture of connector plates.
- B. Fabricator Qualifications: Fabricator shall have a minimum of three (3) years successful experience in the fabrication of metal-plate-connected wood trusses, similar to the trusses required for the project. Fabricator shall have sufficient production capacity to produce, transport, and deliver the trusses without causing delay in the work.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Handle and store trusses to comply with recommendations in TPI BCSI, "Building Component Safety Information: Guide to Good Practice for Handling, Installing, Restraining, & Bracing Metal Plate Connected Wood Trusses".
 - 1. Store trusses flat, off of ground, and adequately supported to prevent lateral bending.
 - 2. Protect trusses from weather by covering with waterproof sheeting, securely anchored.
 - 3. Provide for air circulation around stacks and under coverings.
- B. Inspect trusses showing discoloration, corrosion, or other evidence of deterioration. Discard and replace trusses that are damaged or defective.

PART 2 – PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified Structural Engineer, to design metal-plate-connected wood trusses.
- B. Structural Performance: Provide metal-plate-connected wood trusses capable of withstanding design loads within limits and under conditions indicated. Comply with requirements in TPI 1 unless more stringent requirements are specified below.
 - 1. Design Loads: As indicated.
 - 2. Maximum Deflection Under Design Loads:
 - a. Roof Trusses: Vertical deflection of 1/360 of span.
- C. Comply with applicable requirements and recommendations of the following publications:

1. TPI 1, "National Design Standard for Metal Plate Connected Wood Truss Construction".
 2. TPI DSB, "Recommended Design Specification for Temporary Bracing of Metal Plate Connected Wood Trusses".
 3. TPI BCSI, "Building Component Safety Information: Guide to Good Practice for Handling, Installing, Restraining, & Bracing Metal Plate Connected Wood Trusses".
- D. Wood Structural Design Standard: Comply with applicable requirements in AF&PA's "National Design Specifications for Wood Construction" and its "Supplement".

2.02 DIMENSION LUMBER

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 1. Factory mark each piece of lumber with grade stamp of grading agency.
 2. For exposed lumber indicated to receive a stained or natural finish, omit grade stamp and provide certificates of grade compliance issued by grading agency.
 3. Provide dressed lumber, S4S.
 4. Provide dry lumber with 15 percent maximum moisture content at time of dressing.
- B. Minimum Chord Size for Roof Trusses: As indicated.
- C. Permanent Bracing: Provide wood bracing that complies with requirements for miscellaneous lumber in SECTION 06100 - ROUGH CARPENTRY.

2.03 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Treat all trusses unless otherwise indicated. Comply with requirements for SECTION 06100 - ROUGH CARPENTRY.

2.04 METAL CONNECTOR PLATES

- A. Source Limitations: Obtain metal connector plates from single manufacturer.
- B. General: Fabricate connector plates to comply with TPI 1.

- C. Hot-Dip Heavy-Galvanized-Steel Sheet: ASTM A 653/A 653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 coating designation; and not less than 0.036 inch thick.

2.05 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
1. Provide fasteners for use with metal framing anchors that comply with written recommendations of metal framing manufacturer.
 2. Provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Nails, Brads, and Staples: ASTM F 1667.

2.06 METAL FRAMING ANCHORS AND ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Simpson Strong-Tie Co., Inc.
 2. USP Structural Connectors.
 3. Or approved equal.
- B. Hot-Dip Heavy-Galvanized-Steel Sheet: ASTM A 653/A 653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 coating designation; and not less than 0.036 inch thick.

2.07 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: SSPC-Paint 20, with dry film containing a minimum of 94 percent zinc dust by weight.

2.08 FABRICATION

- A. Cut truss members to accurate lengths, angles, and sizes to produce close-fitting joints.
- B. Fabricate metal connector plates to sizes, configurations, thicknesses, and anchorage details required to withstand design loads for types of joint designs indicated.
- C. Assemble truss members in design configuration indicated; use jigs or other means to ensure uniformity and accuracy of assembly with joints

closely fitted to comply with tolerances in TPI 1. Position members to produce design camber indicated.

1. Fabricate wood trusses within manufacturing tolerances in TPI 1.
- D. Connect truss members by metal connector plates located and securely embedded simultaneously in both sides of wood members by air or hydraulic press.

PART 3 – EXECUTIONS

3.01 INSTALLATION

- A. Install wood trusses only after supporting construction is in place and is braced and secured.
- B. If trusses are delivered to Project site in more than one (1) piece, assemble trusses before installing.
- C. Hoist trusses in place by lifting equipment suited to sizes and types of trusses required, exercising care not to damage truss members or joints by out-of-plane bending or other causes.
- D. Install and brace trusses according to TPI recommendations and as indicated.
- E. Install trusses plumb, square, and true to line and securely fasten to supporting construction.
- F. Space trusses as indicated; adjust and align trusses in location before permanently fastening.
- G. Anchor trusses securely at bearing points; install fasteners as indicated.
- H. Securely connect each truss ply required for forming built-up girder trusses. Anchor trusses to girder trusses as indicated.
- I. Install and fasten permanent bracing during truss erection and before construction loads are applied. Anchor ends of permanent bracing where terminating at walls or beams. Install bracing to comply with SECTION 06100 - ROUGH CARPENTRY.
- J. Install wood trusses within installation tolerances in TPI 1.
- K. Do not alter trusses in field. Do not cut, drill, notch, or remove truss members.
- L. Replace wood trusses that are damaged or do not meet requirements. Damaged trusses may be repaired according to truss repair details signed and sealed by the qualified Structural Engineer responsible for truss design, when approved by the Project Engineer.

3.02 REPAIRS AND PROTECTION

- A. Protect wood trusses from weather. If, despite protection, wood trusses become wet, apply wood treatment to comply with requirements for SECTION 06100 - ROUGH CARPENTRY.
- B. Repair damaged galvanized coatings on exposed surfaces with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

END OF SECTION

SECTION 07190

WATER REPELLENT SEALER

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. A clear water repellent sealer application to all exposed above grade exterior and interior concrete, precast concrete, and concrete unit masonry surfaces of structures that enclose space for human occupancy or for machinery, equipment, or storage.

1.02 REFERENCES

A. American Society for Testing Materials (ASTM):

1. C309 Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
2. C67 Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile

1.03 SUBMITTALS

- A. Product Data: Fully describe all products proposed for use. Include Material Information Sheet for all products.
- B. Manufacturer's ten (10)-year warranty for Water Repellent Sealer.

1.04 QUALITY ASSURANCE

- A. Qualifications: Apply water repellent sealer by a licensed Waterproofing Specialty Contractor exclusively engaged in applying waterproofing materials, sealers, and sealants.
- B. Regulatory Requirements: Comply with International Building Code (IBC), adopted edition.
- C. Trade Association Recommendations:
 1. Comply with recommendations on waterproofing contained in the "Masonry Design Manual" published by the Masonry Industry Advancement Committee.
 2. Comply with the Portland Cement Association recommendations for waterproofing architectural concrete.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver material in labeled unopened containers.
- B. Store all material on raised platforms protected from moisture and from contamination by dirt, mud, or other foreign material.

1.06 COORDINATION

- A. Coordinate with other trades whose work may be damaged by sealer application.
- B. Protect glass and other finished surfaces with polyethylene sheeting taped in place.

1.07 SPECIAL GUARANTEE

- A. Apply sealer under the supervision of the sealer manufacturer's representative.
- B. Provide a signed ten (10)-year Special Guarantee, signed by the sealer manufacturer, applicator, and Contractor against sealer's failure to prevent water intrusion through the treated masonry or concrete.

PART 2 - PRODUCTS

2.01 SEALER

- A. Clear Sealer:
 - 1. Waterbased, solvent-free penetrating clear silane/siloxane water repellent sealer for lightweight concrete block and architectural concrete.
 - 2. Not less than 40% solids content.
 - 3. Meet requirements of Air Quality Management District having jurisdiction.
 - 4. Meet ASTM C67 submersion tests with a repellency rating of 96%.
 - 5. Apply at the rate recommended by the manufacturer for the density, porosity and texture of concrete and/or concrete block used,
 - 6. Manufacturer: Rainguard International "Micro-Seal"; Sherwin-Williams "Loxon 40% Silane Water Repellant LX31T840"; Euclid Chemical "Chemstop WB Regular / Heavy Duty"; or equal.

PART 3 - EXECUTION

3.01 APPLICATION OF CLEAR SEALER

- A. Apply sealer after concrete and masonry has cured at least 30 days, and after the concrete and the masonry has been cleaned.
- B. Prior to applying sealer remove all efflorescence and clean down all masonry and architectural concrete by scrubbing with water and masonry or concrete cleaner and bristle brushes. Do not use muriatic acid or high pressure water cleaning. Allow to fully dry.
- C. Inspect surface for cracks. Rout out all cracks 5 mils and wider and fill with a high-performance joint sealant having a 20-year life expectancy and recommended by the water repellent sealer manufacturer for use on

- substrates to be sealed with his sealer. Perform joint sealant work in accordance with Section 07900.
- D. Test Panel: Apply clear sealer onto a MANDATORY mock wall or test panel. Test the wall or an actual surface area to determine acceptable color, surface porosity, application rates and methods before starting general application.
 - E. Spray-Apply Sealer: Use airless spray equipment with recirculating type pump and perforated T bar applicator recommended by the sealer manufacturer. DO NOT USE pressure pot spray equipment. Operate at lowest possible pressures, 20 psi maximum. Avoid atomizing material by using a spray tip size of .035 to .051. Do not allow fogging or bounce-off except on tension break coat.
 - F. Protect surfaces, which are not to be coated. Cover all anodized aluminum, overhead coiling doors, metal doors, etc. with polyethylene sheeting; continuously seal all edges with tape.
 - G. Apply sealer material in accordance with manufacturer's instructions. Apply enough sealer so the masonry surface appears uniformly wet, for each coat, for from two to five hours after application. Spray head should be held 8 to 12 inches from the surface so that the flood coat runs down the wall approximately 6-12 inches below the point of application.
 - 1. Rate of Application: Coverage as recommended by the manufacturer for porous concrete block, but coverage shall not exceed 40 square feet per gallon for the first coat and 70 square feet per gallon for the second coat.
 - 2. First Coat: Apply the first coat in two passes: the first pass, a light spray to break surface tension; the second pass, a full flood coat applied in an overlapping pattern producing a 6-12 inch rundown.
 - 3. Second Coat: After 48 hours, apply a flood coat in an overlapping pattern producing a 6-12 inch rundown.

END OF SECTION

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SECTION 07410
METAL (ALUMINUM) ROOF PANELS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Metal (Aluminum) Roofing System including metal (aluminum) roofing and associated flashing, insulation, subgirts, sealants, fasteners, and closures necessary to form a weathertight roof panel system as shown on the Drawings and/or specified herein.

1.02 REFERENCES

- A. General: Reference latest edition of applicable codes and standards.
- B. Hawaii State Building Code Council
 - 1. 2018 Hawaii State Building Code
 - 2. 2018 Hawaii State Energy Code
- C. Aluminum Association
 - 1. Aluminum Design Manual.
- D. ASTM International (ASTM):
 - 1. ASTM A653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - 2.
 - 3. ASTM C920 Standard Specification for Elastomeric Joint Sealants
 - 4. ASTM E108 Standard Test Methods for Fire Tests of Roof Coverings
 - 5. ASTM E1592 Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference
 - 6. ASTM E1646 Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference
 - 7. ASTM E1680 Standard Test Method for Rate of Air Leakage Through Exterior Metal Roof Panel Systems
 - 8. ASTM E1996 Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes

- E. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
 - 1. SMACNA Architectural Sheet Metal Manual.
- F. UL Standards for Safety, UL LLC:
 - 2. UL 580 Tests for Uplift Resistance of Roof Assemblies
 - 3. UL 790 Standard for Standard Test Methods for Fire Tests of Roof Coverings
 - 4. UL 2218
Standard for Impact Resistance of Prepared Roof Covering Materials
 - 5. UL Fire Resistance Directory
 - 6. UL Roofing Materials Directory

1.03 SYSTEM DESCRIPTION

- A. Design Requirements:
 - 1. Structural formed metal (aluminum) roof panels of standing seam profile with associated metal flashings.
 - 2. Roof panel system shall be attached to the support substrate with concealed anchor clips designed to allow for thermal movement of the panels. There shall be no exposed fasteners except at panel fixing locations and flashing details or as indicated on approved panel drawings. Snap-on separate seam caps are unacceptable.
 - 3. Roof panel system shall be manufactured and installed to withstand specified design loads and maintain performance requirements without defects, damage, or failure.
- B. Performance Requirements:
 - 1. Design wind loads to meet the requirements of the 2018 Hawaii State Building Code, with adopted amendments.
 - 2. Fire-Test-Response Characteristics: Provide roofing with fire-test-response characteristics indicated, as determined per test method ASTM E108, for application and slopes indicated.
 - 3. Fire-Test Exposure: Class A, UL 790.
 - 4. ASTM A653: Structural (physical) Quality.
 - 5. UL 580: Wind Uplift Resistance.
 - 6. ASTM C920: Specification for Elastomeric Joint Sealants.
 - 7. Impact Resistance: ASTM E1996 per Hawaii Wind Zone Classification and UL 2218.
- C. 2018 Hawaii State Energy Code.
 - 1. The metal roof panel system shall be designed to safely resist a 20-psf roof live load.

2. Roof panels shall be designed for a maximum deflection under positive loading of L/180.
3. Performance Testing: Tests shall be conducted by or witnessed by a recognized independent laboratory or independent professional engineer.
 - a. Air infiltration of the roof panel system shall be limited to 0.036 CFM/ft² at a positive pressure differential of 4 psf when tested in accordance with ASTM E1680.
 - b. There shall be no uncontrolled water penetration to the building interior when the roof panel system is tested per ASTM E1646 at a positive pressure differential of 9.2 psf.
 - c. Allowable uniform uplift load capacity shall be determined in accordance with ASTM E 1592. The factor of safety against ultimate failure of the panel, batten, or clip shall be 1.65, with no increase for wind permitted. Allowable uplift capacity for conditions of gauge, span, or loading other than those tested may be determined by interpolation of the test results. Extrapolation of conditions outside the range of the test is not permitted.
 - d. Roof panel system shall be successfully tested in accordance with UL 580.
 - e. Roof panels shall be thermal cycle tested a minimum of 100,000 cycles with a minimum of 2 inches of movement relative to the clip anchor. Panel and clips shall show that the wear will not affect structural performance or weather integrity of the system.

1.04 SUBMITTALS

- A. Submit product data fully describing all materials proposed for use, test reports, and certifications in accordance with quality assurance and performance requirements specified herein.
- B. Submit panel shop drawings consisting of design and erection drawings, finish specifications, and other data necessary to clearly describe the design, materials, sizes, layouts, construction details, and erection. Submit large-scale details of edge conditions, joints, fastener and sealant placement, flashings, penetrations, and any special details. Distinction must be made between factory and field assembled work.
 1. Drawings must be favorably reviewed prior to fabrication.
- C. Colors/Samples for Initial Selection: Manufacturer's color charts (standard and custom) and samples consisting of units or sections of units showing the full range of colors, textures, and patterns available.

D. Samples:

1. Panel: Representative Architectural samples for color evaluation; minimum 2" x 3" size.
- 2.

1.05 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Manufacturer shall have a minimum of five-year experience in manufacturing metal (aluminum) roof systems. Panels shall be produced in a factory environment (not with a portable roll former with fixed-base roll forming equipment) and in line leveling assuring the highest level of quality control.
 1. Manufacturer shall provide a list of five (5) similar completed projects with addresses of the project location, architect, and owner.
- B. Installers Qualifications: The roof systems contractor shall have had a minimum of 10 years of experience in the successful completion of projects employing similar materials, applications, and performance requirements.
 1. Installation contractor shall be an approved installer, certified by the manufacturer before the beginning of installation of the metal roof system.
 2. The roof systems contractor shall provide a list of five (5) similar completed projects with addresses of the project location, architect, and owner.
- C. Comply with the following regulatory requirements:
 1. 2018 Hawaii State Building Code.
 2. 2018 Hawaii State Energy Code.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Materials shall be delivered to the site in a dry and undamaged condition and unloaded per the manufacturer's instructions. The installer shall inspect materials for damage and stains upon arrival to the site. Materials shall be stored out of contact with the ground in weathertight coverings to keep them dry per the manufacturer's recommendations. Storage accommodations shall provide good air circulation and protection from surface staining.
- B. Handling: Exercise extreme care in unloading, storing and erecting metal roof system to prevent bending, warping, twisting and surface damage.
- C. Storage: Store bundled sheets off the ground sufficiently high enough to allow air circulation beneath bundle and to prevent rising water from entering bundle. Slightly elevate one end of bundle. Prevent rain from entering bundle by covering with tarpaulin, making provision for air circulation between

draped edges of tarpaulin and the ground. Prolonged storage of sheets in a bundle is not recommended. If conditions do not permit immediate erection, extra care should be taken to protect sheets from staining or watermarks. Protect strippable protective coating on any metal coated product from exposure to sunlight and high humidity, except to the extent necessary for material installation.

1.07 WARRANTIES

- A. The warranties below shall not be prorated.
 - 1. Material Substrate Warranty: The manufacturer shall warrant that the metal roof panel substrate will not rupture or perforate due to corrosion within a period of 20 years from date of shipment. Roof panels shall be replaced or refinished at the manufacturer's option.
 - 2. Finish Warranty: The manufacturer shall warrant against fading, chalking, peeling, cracking, checking, chipping, or erosion to base metal of the exterior panel finish, for a period of 10 years minimum.
 - 3. Weathertight Warranty: Manufacturer shall provide a standard weathertight warranty against water penetration of the metal roof panel system, including panel side joint and trim conditions for a period of 10 years from date of substantial completion. Coverage shall be for material and installation.

1.08 SPECIAL GUARANTEE

- A. Provide a written special guarantee signed by the roofing installer or the general contractor extending the standard one-year guarantee to a period of 3 years for work done under this Section. The special guarantee shall not be prorated and shall cover the following:
 - 1. Provide for the repair or replacement of work provided or installed under this Section that leaks or shows other signs of failure.
 - 2. Provide for the repair or replacement of adjoining work necessitated by the above.
 - 3. Provide for the repair or replacement of any other portions of the entire work covered by this contract that are damaged as a result of leaks or other failure of work covered under this Section.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Furnish materials that are all manufactured by a single company.

- B. Aluminum Standing Seam and Batten Roofing: Pac-Clad Metals; BattenLok HS by MBCI; Design Span System by ASC Profiles; or equal (minimum slope of 3:12). Include rain gutters, downspouts, fascias, and flashing contiguous with roofing system.
- C. Fabricate roofing panels and battens in continuous lengths from eave to ridge without intermediate joints or laps.

2.02 MATERIALS

- A. Preformed roofing panels shall be fabricated of .032 Aluminum.
- B. Color shall be as selected from manufacturer's standard colors.
- C. Finish shall be Kynar 500 or Hylar 5000 Fluorocarbon coating with a top side film thickness of 0.70 to 0.90 mil over a 0.25 to 0.3 mil prime coat to provide a total dry film thickness of 0.95 to 1.25 mil. Bottom side shall be coated with a primer with a dry film thickness of 0.25 mil. Finish shall conform to all tests for adhesions, flexibility and longevity as specified by Kynar 500 or Hylar 5000 finish supplier.
- D. Trim: Trim shall be fabricated of the same material and finish to match the profile, and will be press broken in lengths of 10 to 12 feet. Trim shall be formed only by the manufacturer or their approved dealer. Trim to be erected in overlapped condition. Use lap strips only as indicated on Drawings. Miter conditions shall be factory welded material to match the sheeting.
- E. Closures: use composition or metal profiled closures at the top of each elevation to close ends of the panels. Metal closures to be made in the same material and finish as face sheet.
- F. Fasteners: Fasteners shall be of type, material, size, corrosion resistance, holding power and other properties required to fasten miscellaneous framing members to substrates.
 - 1. All self-tapping/self-drilling fasteners, bolts, nuts, self-locking rivets, and other suitable fasteners shall be designed to withstand specified design loads. Use long life fasteners for all interior and exterior metal roof system applications.
 - 2. Provide fasteners with a factory applied coating in a color to match metal roof system application. Provide neoprene washers under heads of exposed fasteners.
- G. Air and Vapor Barrier Underlayment: Polyethylene film and self-adhesive rubberized asphalt modified bituminous sheet membrane to 40-mils thick and with an embossed slip-resistant surface.
 - 1. Grace Ice and Water Shield; equivalent product by Meadows.

2. Reinforced composite aluminum foil with self-adhesive SBS backing and removable poly release film; VapAir Seal MD by Carlisle for direct application over metal decks.
 3. Or equal.
- H. Finish: Smooth texture; Fluoropolymer resin base, thermo-cured two-coat system, 1 mil thickness minimum; Kynar 500; Duranar 200; or equal. Furnish manufacturer's 20-year written guarantee against failure of the finish.
1. Roofing panels, battens and trim will be all one color, selected from manufacturer's standard range.
 2. Rain gutters will be one different color selected from manufacturer's standard range.
 3. Provide factory finished sheet metal components, including flashings and trim to match roof panels.
- I. Accessories: Associated roof jacks, equipment supports, etc. shall be compatible and as approved by roof system manufacturer.
- J. Sealant: One-part elastomeric polyurethane, sealant as recommended in writing by panel manufacturer. Where sealant will be exposed, provide in color to match panels.
1. Vulkem 116; Sikaflex 1a; or equal.
 2. Standard: ASTM C920-86.
- K. Anchor Clips: Concealed anchor clips shall be one (1) piece, 16-gauge G90 galvanized steel, designed to accommodate unlimited, unimpeded panel movement.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine substrate and conditions for compliance with requirements for maximum moisture content, soundness of framing, and other conditions affecting performance of metal roofing. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Clean substrate of any projects and substances detrimental to metal panel roofing. Cover knotholes or other minor voids in substrate with sheet metal flashing secured with roofing nails.

- B. Coordinate installation of metal panels with flashing and other adjoining work to ensure proper sequencing. Do not install roofing until vent stacks and other penetrations through roofing have been installed, are securely fastened and flashing is in place.
- C. Take field measurements before proceeding with the work. Verify that installation may be made in accordance with approved shop drawings and manufacturer's instructions. This specifically includes verifying that the secondary structural members, and/or decking are installed to meet UL and building code requirements. Coordinate with metal roof system manufacturer to ensure that any reduced clip spacing at eave, rake, and corner areas are accommodated.
- D. Discrepancies: In event of discrepancy, notify the Architect and Owner. Do not proceed with installation until discrepancies have been resolved.

3.03 INSTALLATION

- A. General:
 - 1. Install metal roof system so that it is weathertight, without waves, warps, buckles, fastening stresses or distortion, allowing for expansion and contraction.
 - 2. Install metal roof system in accordance with manufacturer's instructions and shop drawings.
 - 3. Provide concealed anchors at all panel attachment locations.
 - 4. Install panels plumb, level and straight with seams and ribs parallel, conforming to design as indicated. Align panels straight and perpendicular to roof eaves and ridges.
 - 5. Lay out battens equidistant from corners or ends.
 - 6. Lay out battens so they meet each other at hips and ridges.
 - 7. Provide panels and battens in one-piece lengths from eaves to ridges.
 - 8. If Strippable coating to be applied on the pre-finished panels to the top side to protect the finish during fabrication, shipping and handling, film shall be removed before installation.
- B. Underlayment: Install in accordance with manufacturer's recommendations. Lay one layer of modified bituminous underlayment, lapping sides 3-12-inches minimum, and ends 6 inches minimum.
- C. Hold-Down Clips: Anchor panel hold-down clips to deck with screws. Space clips 36 inches on centers maximum.
- D. Fasteners: Conceal all fasteners wherever possible. Provide neoprene washers under heads of exposed screws. Locate and space all exposed fasteners in a true vertical and horizontal alignment. Use proper torque

settings to obtain controlled uniform compression for a positive seal without rupturing the neoprene washer.

- E. If not applied by factory, provide a continuous strip of sealant tape or a bead of sealant on each upstanding panel leg prior to installing battens.
- F. Flashing: Provide flashing at all pipes and penetrations through roof. Provide flashing at vertical surfaces adjoining the roof. Install flashing as shown detailed. If not detailed, do work equal to that shown in the SMACNA Architectural Sheet Metal manual to obtain a weathertight and watertight installation.
 - 1. Roof penetrations shall be located between standing seams.
 - 2. Penetrations that require flashing to extend beyond a standing seam shall lap the seam a minimum of 4 inches and follow SMACNA Figure 112, A1.
 - 3. Penetrations larger than the metal panel width shall be centered on a panel and use a curb system similar to SMACNA Figure 113.
- G. Accessories: Provide ribs, cleats, stiffeners, sleeves, hangers, and other reinforcements required to make sections rigid and substantial in the same metal as roofing system.
- H. Sealant: Apply sealant to concealed lap joints and at other locations as required for a watertight installation.
- I. Finish Repair:
 - 1. Touch up scratches and small blemishes with compatible finish material.
 - 2. Replace items that are dented, creased, bent or rusted with new sound items.

3.04 CLEANING AND PROTECTION

- A. Dispose of excess materials and remove debris from site.
- B. Clean work in accordance with manufacturer's recommendations.
- C. Protect work against damage until final acceptance. Replace or repair to the satisfaction of the Owner, any work that becomes damaged prior to final acceptance.
- D. Touch up minor scratches and abrasions with touch up paint supplied by the metal roof system manufacturer.
- E. Do not allow panels or trim to come in contact with dissimilar metals such as copper, lead or graphite.

END OF SECTION

SECTION 07600

FLASHING AND SHEET METAL

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Galvanized steel sheet metal flashing, counterflashing, copings, expansion joints, and all other sheet metal work not covered in other sections.

1.02 REFERENCES

- A. "Architectural Sheet Metal Standards" by Sheet Metal and Air Conditioning Contractors National Association (SMACNA), latest edition.
- B. ASTM International (American Society for Testing and Materials - ASTM):
 - 1. A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - 2. A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
- C. Hawaii State Building Code Council
 - 1. 2018 Hawaii State Building Code
 - 2. 2018 Hawaii State Energy Code

1.03 SUBMITTALS

- A. Product Data: Fully describe all manufactured items to be furnished.
- B. Shop Drawings: Show all custom-fabricated items clearly illustrating the design, dimensions, materials, methods of construction and installation of each piece of work.
- C. Manufacturers' Instructions: For manufactured items.

1.04 QUALITY ASSURANCE

- A. Comply with the adopted edition of the 2018 Hawaii State Building Code, especially Chapters 14, 15 and 25.

B. Where specific details are not provided comply with applicable details in the SMACNA Architectural Sheet Metal Standards.

C. Except where otherwise indicated, comply with minimum thickness or gage requirements as specified in SMACNA Architectural Sheet Metal Manual.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. For unpainted items, deliver all items to the job site, allowing time for field priming and incorporation into work of other trades.

B. Store materials under dry conditions and protect from moisture and physical damage.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Sheet Steel: Copper bearing, 26-gauge or heavier where noted; hot dip galvanized complying with ASTM A653 and A924, G90 Commercial Class 1.25 ounce per square foot, mill phosphatized for maximum paint adherence.
a. Pre-finished metals to have factory finish (Kynar 500 or equal), 24 gauge minimum, color as selected from manufacturer's full range of standard, premium and custom colors.

B. Fasteners:

1. To Concrete Masonry Units: Deformed steel wedge pins driven into lead expansion shields; RAWL, Tapcon, or equal.
2. To Wood Nailers and Sills: Pan head, noncorrosive, sheet metal screws.
3. Component Fasteners: Self-drilling/self-tapping, stainless steel screws, type S-12, Buildex TEKS; Fastenal; or equal.
4. Screw heads shall be furnished with neoprene washers.

C. Sealant: Polyurethane sealant type as specified in Section 07900. Where specified sealant is incompatible with other adjacent sealants, Contractor shall submit a sealant suitable for intended use and of equivalent life expectancy.

D. Isolating Material: Alkali-resistant bituminous paint or varnish.

2.02 FABRICATION

A. Before fabrication, take field measurements, ascertain existing field conditions, and have discrepancies corrected before proceeding with sheet metal work.

- B. Fabricate sheet metal items in the shop to the greatest extent possible. Fabricate using techniques and methods described in the SMACNA Architectural Sheet Metal Standards.
- C. Make sections uniform with true, straight breaks, accurately fitted, and rigidly secured. Provide overlapping tabs for soldered joints. Fabricate items in maximum lengths.
- D. Provide accessories necessary to complete installation. Provide ribs, cleats, stiffeners, sleeves, hangers, and other reinforcements required to make sections rigid and substantial, in same metal as basic unit.
- E. Miter corner joints and reinforce with extended tabs or backing plates.
- F. Soldering: All soldered joints shall lap at least 1-inch. Pre-tin and sweat-solder joints full width. Reinforce all soldered joints with metal rivets. Do not solder aluminum.
- G. Lap expansion joints at least 4 inches and seal with polyurethane sealant, type "B".

PART 3 - EXECUTION

3.01 INSPECTION

- A. Examine surfaces to receive sheet metal work for defects that will adversely affect the execution and quality of the work.
- B. Do not start work until all unsatisfactory conditions are corrected.
- C. Ensure that all wood nailers have been properly installed.
- D. Ensure that all galvanized sheet metal items are prime coat painted on all concealed and exposed surfaces, under Section 09900, before installation.

3.02 WORKMANSHIP

- A. All work shall be watertight and shall drain properly.
- B. Make proper allowance for expansion and contraction of the metals and of the materials to which they are fastened.

- C. Form work accurately to sizes, shapes, and dimensions indicated or necessary, with angles and lines in true alignment, straight and sharp; miters and joints accurately fitted.
- D. Erect work plumb, level and in proper plane, without bulges, or waves. Fit metal closely and neatly to cores or framework. Cope or flange intersections to fit accurately. Reinforce heavily loaded joints with screws or rivets. Corners shall be reinforced, and seams made waterproof. Exposed work shall be free of dents and other defects. Edges of sheet metal shall be hemmed.
- E. Soldering: Pre-tin and apply flux to surfaces of sheet metal. Slowly and thoroughly apply heat to completely sweat the solder through the full width of seam.
- F. Set items in sealant or plastic cement as shown or noted; or when such application is necessary to provide a watertight job.
- G. Provide isolation between dissimilar metals or other materials with sealant, butyl tape, bituminous paint or asphalt saturated felt. Provide waterproof neoprene washers wherever fasteners penetrate sheet metal. Exposed fasteners will not be permitted for any portion of this work.
- H. Perform sealant work in conformance with the requirements of Section 07900.

3.03 FLASHING

- A. Install all Flashings as required to provide watertight protection.
- B. Lap all seams in direction of water flow.
- C. Carry Flashings around corners at least 4 inches.
- D. Lap joints 4 inches minimum. Apply sealant to the overlapping surfaces of the joints. Beads of sealant which will be concealed in the finished work shall be continuous with no voids of material.

3.04 INSTALLATION

- A. Coping Flashing:
 1. Provide flashing/counterflashing as shown on Drawings and as per roof manufacturer's standard details.
 2. Lap joints 3 inches minimum. Lap, miter, and solder at corners.

- B. Provide sill and head Flashing at all louvers, doors and windows as shown and as required for a watertight installation. Furnish in the same metal as the louver.
- C. Provide Flashing where shown and where required for a watertight installation.

3.06 CLEANUP

- A. Clean all finished surfaces, removing all solder, flux, etc. Neutralize soldering flux with a 5 to 10 percent washing soda solution, wash down all work with soap and hot water, flush with clean water, and wipe dry.
- B. Repair or replace all damaged or defective areas to ensure watertightness and neat appearance.

END OF SECTION

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SECTION 07900

JOINT SEALANTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Sealant work required:
 - a. For a watertight project.
 - b. Required by code and not specifically covered in another section.
 - 2. Seal between all door frames, louvers, and adjacent surfaces.
 - 3. Minimum standards for all sealant work whether covered in this Section or in other sections.

1.02 REFERENCES

- A. American Society for Testing Materials (ASTM)
 - 1. C920 Standard Specification for Elastomeric Joint Sealants
- B. Hawaii State Building Code Council
 - 1. 2018 Hawaii State Building Code
 - 2. 2018 Hawaii State Energy Code
- C. Federal Specifications:
 - 1. TT-S-00-1543A Sealing Compound: Silicone Rubber Base (For Caulking, Sealing and Glazing in Buildings and Other Structures)

1.03 SUBMITTALS

- A. Product Data: Fully describe all products proposed for use.
- B. Samples: Physical samples of cured sealants for selection of colors.
- C. Manufacturer's Instructions: Application instructions for all products used.

1.04 QUALITY ASSURANCE

- A. Qualifications: Provide sealant work performed by a licensed Specialty Sealant and Waterproofing Contractor who is exclusively engaged in sealant application work. All work to be performed by qualified journeymen proficient in the craft of sealant application.

B. Regulatory Requirements: Comply with the Hawaii State Building Code, 2018 edition.

1.05 PROJECT CONDITIONS

A. Environmental Requirements: Apply sealant only when temperature and humidity conditions are at the levels recommended by the sealant manufacturer.

1.06 SPECIAL GUARANTEE

A. Provide a written Special Guarantee covering replacement of sealant work that fails within 2 years of the date of project acceptance. Failure includes:

1. Becomes brittle or cracking due to exposure, contraction, or expansion.
2. Failure to resist abrasion of normal use and traffic.
3. Tear failure due to movement within 50% of joint width for Class A sealants.
4. Cohesive or adhesive failure due to movement within 50% of joint width for Fed. Spec. Class A sealants.
5. Water infiltration for joints intended to exclude water, air infiltration for joints intended to exclude air.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Sealant Type "A": Exterior and interior horizontal traffic deck sealant two-part self-leveling polyurethane with a Shore "A" hardness greater than 30, conforming to ASTM C920 Type I or Type II, Class A, in color selected. Acceptable products are:

1. Tremco "Vulkem" No. 245 (use with recommended primer).
2. W.R. Meadows "Pourthane" NS used with recommended primer.
3. Or equal.

B. Sealant Type "B": Exterior and/or interior vertical surface sealant (location as approved by manufacturer) for use in joints in concrete, metal and similar materials, conforming to ASTM C920 Type II, Class A, in color selected. Acceptable products are:

1. One part polyurethane: Tremco "Vulkem" No. 116 (approved for exterior use only).
2. One part polyurethane: Sika Sealant Division Sikaflex 1a.
3. Or equal.

- C. Sealant Type "C": Paintable silicone sealant suitable for sealing cracks, voids, joints, etc. in exterior or interior surfaces that are to be painted or left unpainted. Acceptable products are:
 - 1. G.E. Paintable Silicone Sealant.
 - 2. Dow Corning Paintable Silicone Sealant.
 - 3. Or equal.
- D. Sealant Type "D": Silicone sealant meeting Fed. Spec. TT S 001543A, Class A for use in expansion joints in concrete. Acceptable products are:
 - 1. Dow Corning 795 Silicone.
 - 2. G.E. Silpruf SCS2000.
 - 3. Or equal.
- E. Sealant Type "E": Mildew Resistant Silicone Sealant: One part silicone sealant for sealing non-porous interior surfaces where conditions of high humidity and temperature extremes exist. Acceptable products are:
 - 1. Dow Corning 786 Mildew Resistant Silicone Sealant.
 - 2. General Electric SCS1700 Sanitary Sealant.
 - 3. Or equal.
- F. Sealant Type "F": Two-component, modified polyurethane sealant intended to resist up to five parts per million of chlorine or ozone in water, for interior and exterior use. Acceptable products are:
 - 1. Sika Corp. "Sikaflex-2C."
 - 2. Polymeric Systems, Inc. PSI-270/RC 270.
 - 3. Or equal.
- G. Sealant Backup: Closed Cell Polyethylene rod stock. Acceptable products are:
 - 1. Dow Corning "Ethafoam"
 - 2. Nomaco, HBR Backer Rod.
 - 3. Or equal.

PART 3 - EXECUTION

3.01 CONDITION OF SUBSTRATE

- A. Allow concrete and masonry to cure for at least 28 days before applying sealants.
- B. Inspect substrates to receive sealant work for:
 - 1. Deviation beyond allowable tolerance for joint width and required clear joint depth. Joint width shall not be less than $\frac{1}{4}$ inch or the width shown.
 - 2. Presence of contaminants, which cannot be removed by normal joint cleaning.

3. Presence of moisture. Joint surfaces shall be dry.
- C. Do not start work until all unsatisfactory conditions have been corrected.

3.02 PREPARATION OF SURFACES

- A. Clean surfaces that the sealant is to adhere:
 1. For Concrete and Masonry: Sandblast joint surfaces taking care to protect exposed finish surfaces.
 2. For Metal: Sand or scrape and solvent clean with a non-film forming solvent.
- B. Ensure that cleaned surfaces are not contaminated before applying sealant.

3.03 APPLICATION

- A. Follow sealant manufacturer's published instructions.
- B. Install sealant backup the proper distance from face of joint for joint proportioned in accordance with sealant manufacturer's recommendations. Use polyethylene rod stock larger than joint so that backup can be firmly held in place.
- C. Apply primer and/or cleaner conditioner recommended by sealant manufacturer for substrate. Avoid getting primer on the face of material or on areas that will not be covered by sealant.
- D. Mask edges of joint with masking tape where required to avoid contamination of exposed surfaces adjacent to joint.
- E. Apply self-leveling sealant by pouring, pumping, or with a caulking gun. When using a pump or caulking gun, fill joint from the bottom up to avoid air entrapment. Fill joint flush with surface of adjacent material without overfilling or spilling sealant on exposed surfaces.
- F. Apply vertical grade sealants by hand or power operated caulking gun. Use a caulking tip the proper width for the joint required. Fill the joint from the bottom up to insure a fully filled joint without entrapped air bubbles or voids. Use lubricant recommended by sealant manufacturer to tool joints. Force sealant against sides and bottom of joint and into all crevices; press out air bubbles and voids. Tool the sealant surface smooth and flush with adjacent surfaces for butt joints or to an even, straight-sided fillet of uniform width and slope for fillet joints.

G. Where the substrate or adjacent sealants are incompatible with the specified sealant, submit a sealant suitable for the required use and of equivalent life expectancy to the specified sealant.

3.04 EXPANSION JOINTS

- A. Apply sealant in expansion joints when the joint opening width is approximately halfway between dimensional extremes of thermal movement.
- B. Place sealant backer rod the proper distance from face of joint to ensure that sealant bead depth is never more than half the bead width at any time between dimensional extremes of joint.

3.05 CLEANUP

- A. Upon completion, remove protective masking and clean any sealant from adjacent finished surfaces beyond edge of joint.

END OF SECTION

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SECTION 08110
HOLLOW METAL WORK

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. All hollow metal work including:
 - a. Doors and frames.

1.02 REFERENCES

- A. American Nation Standards Institute (ANSI):
 - 1. ANSI A250.4 Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors
 - 2. ANSI A250.8 Specifications for Standard Steel Doors and Frames
- B. ASTM International (ASTM):
 - 1. ASTM A1008 Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
 - 2. ASTM A653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - 3. ASTM A1011 Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
 - 4. ASTM E283 Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
- C. Glass Association of North America (GANA):
 - 1. GANA – Glazing Manual.
 - 2. FGMA – Sealant Manual
- D. Hawaii State Building Code Council
 - 1. 2018 Hawaii State Building Code
 - 2. 2018 Hawaii State Energy Code
- E. National Association of Architectural Metal Manufacturer's (NAAMM) "Guide Specification for Commercial Laminated Core Hollow Metal Doors and Frames, HMMA 867-16.
- F. Steel Door Institute (SDI):

1. ANSI/SDI A250.4 Standard Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors.
- G. Underwriters Laboratories, Inc.:
1. UL 1784 Standard for Air Leakage Tests of Door Assemblies and Other Opening Protectives

1.03 SUBMITTALS

- A. Product Data: Fully describe all products proposed for use. Include data and details on door construction including internal reinforcement and door edge construction.
- B. Shop Drawings: Submit custom prepared project-specific shop drawings showing dimensions and details. Include a schedule showing locations of doors and frames complete with listing of types and styles. Field measure before ordering. Provide frames with throat opening size required by field conditions regardless of size shown on drawings. Review of door frame submittal DOES NOT include review of throat opening dimension for compatibility with field requirements or Contract Documents.
- C. Manufacturers' Certificates of Compliance: Before delivery of doors, frames, and accessories, submit certificates from the manufacturer attesting that doors, frames and accessories meet the requirements of the referenced standards.

1.04 QUALITY ASSURANCE

- A. Regulatory Requirements:
 1. Comply with the following:
 - a. 2018 Hawaii State Building Code.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Inspect doors, frames, and accessories delivered to the site for damage. Unload and store with a minimum of handling. During delivery, strap door frames of welded unit construction together in pairs with the head of one frame inverted for bracing. Replace doors and frames damaged during delivery.
- B. Provide a bottom spreader bar tack welded to frames to maintain jamb alignment until frames are installed.
- C. Storage: Store doors and frames carefully on platforms under cover in dry and accessible locations, which are adequately ventilated and free from dust or water and which permit easy access for inspection and handling. Avoid the use of non-vented plastic or canvas shelters that create a humidity chamber.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Acceptable manufacturers include Folderer Hollow Metal Products; Republic; Steelcraft; or equal.

2.02 MANUFACTURED UNITS

A. Frames, Galvannealed:

1. Fabricate from carbon steel sheet that has been coated by a continuous hot-dip process and further treated to convert the zinc coating into a zinc-iron alloy meeting ASTM A653 A60.
2. Minimum zinc coating: 0.60 total both sides ounces per square foot of metal surface.
3. Metal thickness: .067 in. or heavier where noted.

B. Doors, Galvannealed:

1. Fabricate face sheets and edge channels from carbon steel sheet that has been coated by a continuous hot-dip process and further treated to convert the zinc coating into a zinc-iron alloy meeting ASTM A653 A60 or A1008 commercial class 0.60.
2. Minimum Zinc Coating: 0.60 ounces per square foot of metal surface.
3. Metal Thickness: .053 in. or heavier where noted.

C. Insulated Doors – Core Construction:

1. Foamed in place polyurethane and steel reinforced core with no stiffener face welds.
2. Provide 18-gauge steel vertical reinforcements 6 inches apart and welded in place. Foamed in place polyurethane core is chemically bonded to all interior surfaces. No face welding is permitted.
3. Thermal properties to rate at a fully operable minimum U-Factor and R-Value (including insulated door and thermal-break frame) as shown on Drawings.

D. Jamb Anchors:

1. Provide the number of anchors required by the fire rating but not less than the following number for each jamb.
 - a. Frames up to 7'-6" high, three anchors.
 - b. Frames 7'-6" to 8'-0" high, four anchors.
 - c. Frames over 8'-0" high, four anchors plus one additional anchor for each 2 feet or fraction thereof above 8 feet.
 - d. Provide head anchors at 2-foot centers for openings wider than 3 feet.
2. Frames in Masonry Walls: Provide adjustable tee strap, jamb anchors. Metal thickness: .053 in. minimum.
3. Provide special anchors when specified or detailed.

- E. Floor Anchors: 0.053 in. minimum thickness, welded to frame at each jamb or mullion, punch for two 3/8-inch-diameter anchor bolts. Additional jamb anchors do not waive the requirement for floor anchors.
- F. Transom Glass:
 - 1. Glazing: Composed of clear 1/4" thick tempered safety glass.
 - 2. Glazing Tape: Closed cell polyvinyl chloride (PVC) foam, coiled on release paper over adhesive on two sides, maximum water absorption by volume of percent.
 - 3. Silicone Sealant: One-part neutral curing silicone, medium modulus sealant,
Type S; Grade NS; Class 25 with additional movement capability of 50 percent in both extension and compression (total 100 percent):
 - a. Dow Corning 795 - Dow Corning Corp.
 - b. Silglaze-II 2800 - General Electric Co.
 - c. Spectrem 2 - Tremco Inc.
 - 4. Setting Blocks: Neoprene, EPDM, or silicone; tested for compatibility with glazing compound; of 70 to 90 Shore A hardness.
 - 5. Cleaners, Primers, and Sealers: Type recommended by manufacturer of glass and gaskets.

2.03 FABRICATION

- A. General: Fabricate in the shop. Accurately fit all work and fabricate in a manner to produce smooth, even surfaces free from warp, wave, buckle and other defects. Make square corners and angles unless shown otherwise on the Drawings. Set members in proper alignment, with edges straight and clean. Make provisions for hardware at locations in accordance with prevailing accepted standards, and as shown on the Drawings.
- B. Galvannealed Doors and Frames, Where Required: All exterior doors and frames shall be galvannealed. All other doors and components noted, specified or scheduled "Galvanized" shall be galvannealed.
- C. Preparation for Hardware: Make to hardware templates and physical hardware. Locate center of panic hardware pushbars, door knobs, and lever handles 38 inches above the floor. Locations shall be coordinated between frames and doors, as shown on the Drawings, and all applicable accessibility and other code requirements. Punch stops of all frames for silencers, three in latching stop for single doors, two in head of double door frames.
- D. Frames: Fully welded, seamless construction with no visible seams or joints, strong, rigid and constructed so as not to bind, sag, twist or otherwise fail in

use. Provide frames with throat opening dimension required to meet field requirements regardless of throat size shown.

1. Frame members: Form each frame member from one piece of sheet steel.
2. Joints: Miter corner joints, including integral stops, reinforce and weld continuously full length of joint. Fit other joints neatly and weld continuously full length of joint.
3. Jamb anchors: Weld to inside jamb.
4. Floor anchors: Weld to bottom of door frame jambs.
5. Spreaders: Connect removable steel channel spreader ties across bottoms of welded door frames to hold rigid during shipping and until they are secured in place in the work.
6. Hardware reinforcing: Weld in place, comply with NAAMM HMMA 867-16 standards. Shop drill and tap for template hardware. Field-drill and tap for surface mounted hardware.
 - a. Templates: Obtain from finish hardware manufacturer.
 - b. Hinges: 7-gauge steel, 1-1/4 inches wide by not less than 10 inches long. Prepare for full mortise hinges.
 - c. Strikes: 12-gauge steel, 1-1/2 inches wide with minimum lap of 2 inches beyond cutout.
 - d. Closers: 12-gauge steel, length to accommodate closer. Provide reinforcing at two locations on each frame for installation of either regular or parallel arm closers, whether or not closers are scheduled.
 - e. Plaster guards: 24-gauge steel, provide at strike and hinge reinforcing.
 - f. Flush bolts: 12-gauge steel.
7. At exterior locations and where noted, provide shop welded 0.53 in. galvanized steel rain hood at head of door frame.

E. Doors:

1. Type: SDI Type III, extra heavy duty, fully welded style 2 full flush hollow steel construction for interior doors and exterior doors. Doors shall have no visible joints or seams on exposed faces and vertical edges.
2. Top and bottom rails: .053 in. channel; fully flush design, continuous welded to face sheets.
3. Face sheet (or face panel) reinforcing shall meet the requirements of ANSI A250.4 for twist strength. The following methods are acceptable:
 - a. Continuous vertical stiffeners of not lighter than .026 in. steel, spaced not to exceed 6 inches on centers and spot welded to both face sheets at intervals not greater than 6 inches. Fill all voids with insulation.
 - b. An inner grid system consisting of vertical and horizontal members of not lighter than .042 in. steel, welded or interlocked for maximum strength and spaced not to exceed an average of 12 inches in either direction, and spot welded to both face sheets at intervals not greater than 6 inches. Fill all voids with insulation.

- c. A continuous formed sheet steel truss core, full height and width, spot welded to face sheet at intervals not greater than 6 inches in both directions. Fill all voids with insulation.
 - d. Doors required to have a maximum temperature rise on the protected side shall have insulating cores as required to achieve the specified performance.
4. Edge profile: Bevel vertical edges of stiles 1/8-inch in 2 inches.
 5. Door thickness: 1-3/4 inches or thicker as noted.
 6. Clearances: 3/32-inch clearance at jambs and head and 3/8-inch clearance at bottom; 1/4-inch clear between door and threshold where threshold occurs. Provide required clearance between door and stop to accommodate smoke gasket.
 7. Exterior doors: Provide a watertight flush closing channel at the top edge. Provide weep holes in the bottom closure to permit escape of entrapped moisture.
 8. Door cutouts: Cut outs for door openings shall be spaced at least the distance away from door edges or recesses for hardware that is required to maintain door fire rating and guarantee. All cut outs shall be made in the shop fabricating the doors.
 9. Hardware reinforcing: Comply with NAAMM HMMA 867-16 Standards. Shop drill and tap for template hardware. For surface mounted hardware, drill and tap in the field.
 - a. Hinge: .167 in.
 - b. Lockset: .093 in.
 - c. Flush bolt: .093 in.
 - d. Closer: .152 in.
 10. Provide reinforcement for closers both sides of all interior doors whether closers are scheduled or not.

2.04 FINISHES

- A. Refer to Section 09900 for surface preparation, pretreatment, primers, and application techniques.
- B. Apply one shop coat of rust inhibiting primer to all ferrous metal not scheduled to be galvanized.
- C. Galvanized work is to be prepared and field prime painted coat and finish coat painted under Section 09900. DO NOT SHOP-PRIME GALVANIZED WORK.

2.05 GALVANIZING REPAIR

- A. Repair damaged galvanizing by heated substrate repair method. Repair materials shall be Galv Bar as manufactured by US Alloy Company; or Gal-Viz as manufactured by The Harris Products Group; or equal.
 1. Heat substrate to 600°F, or apply hot process touch-up material right after welding before metal has cooled below 600°F.

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2. Rub bar of specified galvanize repair material over surface of hot substrate to apply a uniform coating of zinc. Wire brush hot coating with a clean wire brush to smooth out and bond zinc coating to substrate.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Frames: Set accurately in position, plumbed, aligned and braced securely until permanent anchors are set. Anchor bottom of frames securely to floors. Secure wall anchors to adjoining construction as indicated or required.
- B. Hanging Doors: Set accurately, snug against all stops and free from hinge bind. If shimming is required use sheet brass shims. Install hardware and weatherstripping. Adjust closing and latching speed of door closers for smooth operation, self-closing and automatic positive latching. Fasten with matching machine screws or bolts at all points where fasteners are indicated or required. Leave hardware in perfect working order. Clean and polish.
- C. Protect glass from edge damage during handling and installation. Inspect glass during installation and discard pieces with edge damage that could affect glass performance. Set units of glass in each series with uniformity of pattern, draw, bow, and similar characteristics.
- D. Cut glazing tape to length and set against permanent stops, flush with sight lines to fit openings exactly, with stretch allowance during installation. Place setting blocks located at quarter points of glass with edge block no more than 6 inches from corners.
- E. Glaze vertically into metal frames and push against tape for full contact at perimeter of pane or unit. Place glazing tape on free perimeter of glazing in same manner described above. Install removable stop and secure without displacement of tape.
- F. Remove locksets, kickplates, etc. for field painting of doors. Replace hardware after painting work is completed.
- G. Repair damaged galvanizing by the heated substrate repair method using galvanized touch-up material specified in Part 2 of this Section.

END OF SECTION

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SECTION 08310
ACCESS HATCHES

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes the design, furnishing, and installation of pre-engineered, factory fabricated horizontal metal access hatches for wastewater wet wells.

1.02 REFERENCES

- A. Aluminum Association:
1. Aluminum Design Manual: Part 1 – A Specification and Guidelines for Aluminum Structures, 2020
- B. American Institute of Steel Construction (AISC).
- C. ASTM International (ASTM):
1. ASTM C1802 Standard Specification for Design, Testing, Manufacture, Selection, and Installation of Horizontal Fabricated Metal Access Hatches for Utility, Water, and Wastewater Structures
- D. American Welding Society (AWS):
1. AWS A5.3 Aluminum and Aluminum Alloy Electrodes for Shielded Metal Arc Welding
2. AWS D1.2 Structural Welding Code - Aluminum
- E. Hawaii State Building Code Council:
1. HSBC Hawaii State Building Code, latest edition
- F. International Code Council (ICC):
1. IBC International Building Code, latest edition

1.03 SUBMITTALS

- A. Product Data:
1. Fully describe all items proposed for use. Include sufficient data to show that products conform to specification requirements as indicated herein, and in the Drawings. Product data shall include the following:
a. Load rating of access hatch,
b. Hatch accessories,
c. Materials type and grade.
- B. Shop Drawings: Show dimensions, attachments, latches, inserts, and relationship of work to adjoining construction.

1.04 WARRANTY/QUALITY ASSURANCE

- A. Manufacturer:

1. The pre-engineered, factory fabricated access hatch manufacturer shall have a minimum of 10 years' experience in the manufacturing of similar products at similar locations.
- B. The installer shall have a minimum of 5 years' experience in the installation of similar products at similar locations.
- C. Regulatory Requirements:
 1. Applicable State of Hawaii Occupational Safety and Health (HIOSH) Regulations.
 2. IBC, insert year edition.

1.05 WARRANTY

- A. Manufacturer's Warranty:
 1. Provide manufacturer's standard warranty.
 2. Materials shall be free of defects in materials and workmanship for a period of 25 years from the date of purchase. Should a part fail to function in normal use within this period, the manufacturer shall furnish a new part at no cost to the Owner.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Handle, ship, and store material in a manner that will prevent distortion, rust, damage to the shop coat or any other damage. Deliver products in manufacturer's original packaging.
- B. Inspect all hatches upon delivery at the site and notify the fabricator of any discrepancies or damage prior to installation.
- C. Ensure dissimilar metals are not in contact with each other.
- D. In the event of damage, immediately inform the Construction Manager. Make no repairs without approval from the fabricator. Replacement, if necessary, shall be timely and at no additional cost to the Owner.

PART 2 - PRODUCTS

2.01 ACCESS HATCHES

- A. Access Hatch Schedule:

Hatch Location (Clear Dimensions)	No. of Leaves	Material Type	Live Loads (Vertical Forces)	Special Requirements
3 hatches total, one located over each pump. (Minimum Clear opening 4'-0" x 2"-6") <i>Note: Hatches sized for retrieval of future pumps.</i>	Double	Aluminum	300 pounds per square foot	1. Lockable 2. Provide Warning Sign 3. Safety Grating

- B. Minimum clear opening dimensions of each hatch shall be as shown under "Special Requirements" in the Access Hatch Schedule. Coordinate with the favorably reviewed pump manufacturer if larger in size. Provide double leaf hatches as indicated in the Access Hatch Schedule.
1. Double Leaf: USF Fabrication, ASG-HD; equivalent by L.W. Products Co.; equivalent by EJ; or approved equal.
- C. Doors:
1. Minimum 1/4-inch thick, diamond pattern, reinforced as required to withstand the specified loads. See Access Hatch Schedule for more information.
 2. Deflection shall not exceed 1/150th of the span.
 3. Doors shall open to minimum 90 degrees and shall include an automatic hold-open arm with a positive automatic latch that will secure the door in the open position until the release handle is activated.
 4. Provide stainless steel hold-open pin through holes in hold-open arms to ensure against accidental hatch closure. Attach pin to hatch with a short stainless-steel chain to prevent loss.
 5. Door hinges shall be recessed or flush.
- D. Frame:
1. Minimum 1/4-inch thick material to match the doors, channel with anchor flange around perimeter for embedment into concrete.

2.02 ACCESSORIES

- A. Lock: Provide a slam-lock with removable handle or a recessed keyed cylinder lock with a removable or recessed or drop-down flush lifting handle(s)

- B. Lift-Assist Mechanism: Provide stainless steel compression spring(s) or pneumatic spring(s) enclosed in sealed telescoping tube(s).
- C. Safety Chain: For double leaf doors, provide a stainless-steel safety chain between doors at the opposite end from the latch to form a barrier when the doors are locked in the open position.
- D. Safety Grate:
 - 1. Where indicated in the Access Hatch Schedule, provide a secondary fall protection safety grate located beneath the solid hatch cover, which lifts independently from the cover and is equipped with a latch to hold it in the open position.
 - 2. The grate shall be manufactured from aluminum flat bars and safety orange in color. The grate shall comply with HIOSH standards for fall protection.
 - 3. The grate shall have a padlock hasp for locking in the closed position.
- E. All non-aluminum metals and hardware: Type 316 stainless steel.
- F. Finish:
 - 1. Mill finish aluminum.
 - 2. All surfaces of aluminum in contact with concrete shall be coated for isolation in accordance with Section 05500.
- G. Warning Sign(s):
 - 1. Provide a sign or decal permanently attached to the underside of hatch doors reading: "Warning: Permit Confined Space Entry."

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Deliver hatches to job site in time for installation in the concrete placement.
- B. Coat all aluminum surfaces, which will be in contact with concrete, in accordance with Section 05500.
- C. Make connection of drainage coupling to plumbing drain line prior to the concrete pour.
- D. Install in conformance with the manufacturer's installation instructions. Set frame level and true to plane at all four corners, and flush with adjacent finished surfaces. Doors, when closed, shall be flush with frames and flush with each other. Doors, when closed, shall be flush with frames and flush with each other.
- E. Adjust watertight hatches as required and as recommended by the manufacturer to provide a leakproof assembly.
- F. Install specified warning sign.

END OF SECTION

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SECTION 08700

FINISH HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Furnish and install all commercial finish hardware.
 - 2. Door hardware includes, but is not necessarily limited to, the following:
 - a. Mechanical door hardware.
 - 3. Coordination, preparation, and installation of Finish Hardware by a certified Architectural Hardware Consultant (AHC).

1.02 REFERENCES

- A. American National Standards Institute (ANSI) and Builders Hardware Manufacturer's Association (BHMA) Product standards for all specified items:
 - 1. A156.1 Butts and Hinges
 - 2. A156.2 Bored and Preassembled Locks and Latches
 - 3. A156.3 Exit Devices
 - 4. A156.4 Door Controls-Closers
 - 5. A156.5 Auxiliary Locks and Associated Products
 - 6. A156.6 Architectural Door Trim
 - 7. A156.7 Template Hinge Dimensions.
 - 8. A156.8 Door Controls-Overhead Holders
 - 9. A156.13 Mortise Locks and Latches
 - 10. A156.15 Closer Holder Release Devices
 - 11. A156.16 Auxiliary Hardware
 - 12. A156.18 Materials and Finishes
- B. Americans with Disabilities Act (ADA):
 - 1. 2010 ADA Standards for Accessible Design
- C. Door and Hardware Institute (DHI):
 - 1. Basic Architectural Hardware
 - 2. Abbreviations and Symbols
- D. Underwriters Laboratories Inc.:
 - 1. UL 305 Panic Hardware
 - 2. UL 1784 Standard for Air Leakage Tests of Door Assemblies and Other Opening Protectives
- E. National Fire Protection Association:
 - 1. NFPA 105 Standard for Smoke Door Assemblies and Other Opening Protectives

1.03 SUBMITTALS

- A. Product Data: Fully describe every product proposed for use. Clearly identify substitutions or changes, as a result of coordinating hardware components.
- B. Shop Drawings: Submit hardware list and schedule prepared by a certified Architectural Hardware Consultant in accordance with DHI recommendations. The Owner's review of schedule shall neither be construed as a complete check, nor shall it relieve the Contractor of responsibility for errors, deviations, or omissions from the specified requirements to provide complete door hardware for the Project. Organize the hardware list and schedule in the same order as the Door Hardware Schedule at the end of Part 3 of this specification Section. Include the following information:
 1. Type, style, function, size, label, hand, and finish of each door hardware item.
 2. Manufacturer of each item.
 3. Fastenings and other pertinent information.
 4. Location of each door hardware set; cross-referenced to the Door Hardware Schedule.
 5. Explanation of abbreviations, symbols, and codes used in the schedule.
 6. Mounting locations for door hardware. Supply templates to door and frame manufacturers to enable proper and accurate sizing and locations of cutouts for hardware.
 7. Manufacturer's Instructions: For mounting, installing, and adjusting hardware. Installation instructions shall be available at jobsite during construction for reference.
 8. Door and frame sizes, materials, hand, and door rating.
 9. Description of electrified door hardware sequences of operation and interfaces with other building control systems.
- C. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication, and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
- D. Keying Schedule: Contact Owner representative for information regarding Owner's keyway system. Prepared under the supervision of the Owner, separate schedule detailing final keying instructions for locksets and cylinders in writing. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner to approve submitted keying schedule prior to the ordering of permanent cylinders.
- E. Warranties: Submit special warranties as specified in this Section.
- F. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for the Owner's continued adjustment, maintenance, removal, and replacement of door hardware. For each type of door hardware to include in maintenance manuals

G. PRODUCT TEST REPORTS:

1. Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer, and witnessed by a qualified independent testing agency.

H. OPERATING AND MAINTENANCE MANUALS: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals. The manual to include the name, address, and contact information of the manufacturers providing the hardware and their nearest service representatives. Include final hardware and keying schedule. The final copies delivered after completion of the installation test to include "as built" modifications made during installation, checkout, and acceptance.

1.04 QUALITY ASSURANCE

A. Hardware Supplier:

1. Engaged in supplying builder's hardware for commercial projects of similar nature and comparable size for at least 5 years.
2. Has a full-time certified Architectural Hardware Consultant (AHC) on staff that will prepare the hardware submittal and supervise installation of all finish hardware.

B. Architectural Hardware Consultant (AHC) Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as follows:

- a. For door hardware, an Architectural Openings Consultant (AOC).

C. Perform Work in accordance with the following requirements:

1. ANSI/BHMA A156 Series
2. UL 305

D. Regulatory Requirements:

1. 2018 Hawaii State Building Code shall be used as the primary regulatory requirement for access individuals with disabilities. Federal and other State disabled access requirements shall be followed for conditions not regulated by the Hawaii State Building Code.
2. 2010 ADA Standards for Accessible Design.

E. SOURCE LIMITATIONS: Obtain each type and variety of Door Hardware specified from a single source and qualified supplier unless otherwise indicated.

F. MEANS OF EGRESS DOORS: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

1.05 SPECIAL WARRANTY

1. Door Hardware:

- a. Structural failures including excessive deflection, cracking, or breakage.
 - b. Faulty operation of doors and door hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
2. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.
 - a. Mortise Locks and Latches: Ten years
 - b. Exit Devices: Five years.
 - c. Manual Closer: 10 years.

1.06 MAINTENANCE SERVICE

1. Maintenance and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

1.07 DELIVERY

- A. Deliver hardware with items for each opening packed together, complete, and ready for installation with necessary fittings, trim, fasteners and accessories. Mark packages with opening number for identification.
- B. Deliver permanent keys, cylinders, cores, and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the Keying Conference. Deliver templates and installation instructions.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Provide hardware that complies with applicable building code requirements. Provide all hardware, smoke gaskets, and thresholds listed for a fire assembly of the required rating for all doors required to be fire rated.
- B. Provide hardware that fits perfectly, is of uniform color, and is free of imperfections affecting serviceability or marring appearance.
- C. Deliver hardware in a timely manner as required by the Contractor's Schedule. Furnish materials or templates to others when required for factory installation or preparation.
- D. Provide adequate functioning hardware for all doors whether scheduled or not.
- E. Where the hardware manufacturer's product number specified does not provide hardware meeting fire codes, condition of use, function, hand, mounting conditions, strikes, stops, keepers or fasteners required for a

- satisfactory installation, provide items of equivalent quality or better meeting applicable project conditions.
- F. Hardware shall be from one manufacturer for each item specified in Part 2.
 - G. Coordinate with the work of other trades in furnishing and placing finish hardware.

2.02 HARDWARE

- A. Fasteners: Furnish all necessary screws, bolts or other fastenings of suitable size and type to anchor the hardware in position for heavy use and long life; provide fasteners that match the material and finish of the hardware. Where necessary, provide expansion shields, sex bolts, screws, or other anchors appropriate for substrate that the hardware is installed on. Provide machine screws and soft metal expansion shields to fasten hardware to concrete, masonry, plaster, and similar materials. Plastic or fiber inserts are not acceptable.
- B. Finish: Provide all steel hardware with the following finish:
 - 1. US32D (630) satin stainless steel.
 - 2. Aluminum hardware shall be clear anodized unless otherwise noted.
- C. Locksets:
 - 1. Cylindrical Locksets: BHMA A156.2 Heavy duty, with interior parts of stainless steel and other noncorrosive metals. Provide key-in-knob, 6-pin cylinders to match Owner's keyway. Schlage Series "C" with stainless steel mechanism with lever handle (lever shall be curved with a return to within ½ of the door), "Rhodes;" Corbin Russwin "CL3100;" or equal. Provide UL-rated latch bolts for fire-rated doors.
 - 2. Mortise Locksets: BHMA A156.13 Heavy duty, with 6-pin cylinder matching Owner's system. Schlage "L" Series; Corbin 9700 Series; or equal. Provide lever handles (lever shall be curved with a return to within ½ of the door), Design: Schlage 03; Corbin ML2000 Series; or equal.
 - 3. Backset: 2-3/4 inches.
 - 4. Strikes: Furnish standard strikes with curved lip extended to protect trim from being marred by latch bolt. Provide dust boxes. Verify whether standard or ANSI cutouts are provided in metal frames.
 - 5. Cylinder Guards: Free spinning, tapered, to prevent the forced unscrewing of the lock cylinder. Keedex or equal.
- D. Keys and Keying:
 - 1. All keyed locksets and padlocks shall be supplied with interchangeable core cylinders to match the Owner's interchangeable core and keying system.
 - 2. All cylinders shall be supplied with temporary construction cores for Contractor's use. Permanent cores shall be delivered directly to the Owner's Representative.

3. Tag keys with location, and schedule heading number and deliver them to Owner upon completion of work. Deliver permanent keys directly to Owner.
- E. 4. Furnish construction keying. Provide construction master keyed cylinders or temporary keyed construction cores. Provide construction master keys in quantity as required by project Contractor. Replace construction cores with permanent cores. Deliver two (2) extra keys directly to the Owner's Representative. Retain construction keys and cores for future lockout purposes.
 1. Keying: Interchangeable 6-pin cylinders matching Owner's keyway.
- F. Hinges:
 1. Butts, Full Mortised. Conform to ANSI/BHMA A156.1. Provide heavy weight, 5-knuckle ball bearing stainless steel butts for interior doors and heavy weight 5-knuckle stainless steel ball bearing butts for exterior doors.
 2. Stanley FBB199 for interior doors, Stanley FBB199 for exterior doors, McKinney, or equal.
 3. Provide non-removable pins for all exterior outswinging doors.
 4. Unless otherwise specified, determine the size of the butts by the following table:
 - a. Doors 1-¾-inch thick and up to 42-inch wide to have 4-½-inch.
 - b. Doors 2-inch-thick, and 1-¾-inch doors over 42-inch wide to have 5-inch extra heavy.
 5. Provide widths sufficient to clear trim projection when door swings 180 degrees.
 6. Provide three (3) hinges to 90-inch high for each door leaf:
 - a. Four (4) hinges to 120-inch high for each door leaf.
 - b. Five (5) hinges to 150-inch high for each door leaf.
 - c. Six (6) hinges to 180-inch high for each door leaf.
- G. Closers: Provide heavy-duty door closers of one manufacturer; non-handed double arm, with metal covers full rack and pinion type ANSI/BHMA A156.4 Grade 1 with steel spring and non-gumming, non-freezing hydraulic fluid; non-sized adjustable for interior doors to 5 feet wide and exterior doors to 4 feet wide (cylinder sizes 1 through 6).
 1. Provide controls for regulating closing, latching speeds and back check non-handed double arm. Provide all closers with a cushion stop built into closer arm that can be adjusted to stop door opening at a pre-set angle. Provide closers designed with spring power adjustment required for easy opening usable by the physically disabled; 8.5 [5] pounds for exterior doors and 5 pounds for interior doors.
 2. Provide parallel-arm closers at reverse bevel doors and where doors swing full 180 degrees.
 3. Include all through bolts, mounting brackets, mounting plates, shoes, and accessories required for proper function and installation.

- 4. Furnish hold open arms when specified. Provide maximum degree of opening attainable consistent with closer function specified.
- 5. Provide plated finish on metal cover, arm, and fasteners.
 - a. Acceptable Manufacturers:
 - 1) LCN 4111 Series or equal; plated finish.
- H. Exit Devices, Touch bar type: Heavy-duty type UL listed for accident hazard and capable of meeting UL "A" label rating, rim latch or mortise design with 3/4-inch anti-friction latch bolt. Latch bolt shall retract when horizontal pressure is exerted on touch bar. Latch bolts on vertical rod devices shall remain retracted until door closes. Plate all exposed surfaces to match hardware finishes. Provide stainless steel touch bars, US32D finish.
- I. Doorstop, Floor-Mounted: Stainless steel or solid brass plated to match hardware. Provide risers to increase height as required to suit conditions.
- J. Doorstop, Wall-Mounted: Stainless steel or solid brass plated to match hardware. Furnish with durable high-grade shock-resistant rubber bumper.
- K. Doorstop/Holder, Floor-or Wall-Mounted: Provide a strike with a hinged hook that fits flush with the strike when unit is acting as a stop only. The hook is manually lifted to engage the hold-open lug. When released, the hook drops back flush with the strike. Provide in stainless steel or solid brass finished or plated to match hardware. Note: UL requirements do not permit hold-open feature on fire-rated door assemblies.
- L. Kick-Down Door Hold Open: Rockwood Kick Down Door Stop w/ Rubber Bumper Satin Chrome - 461-US26D; or equal.
- M. Kickplates: All material shall be stainless steel, bronze or brass finished to match hardware, 0.050 gauge with beveled edges, 12-inch high x 1-1/2-inch narrower than single door or 1-inch narrower than pairs of doors.
- N. Thresholds: Furnish white or yellow bronze thresholds to match other door hardware unless noted otherwise. Anodized aluminum is not acceptable.
- O. Silencers: Pneumatic rubber, installed in metal frame stops. Furnish three for single doors and two for pair of doors. Omit silencers where door seal occurs and for exterior doors.
- P. Weatherstripping: Provide door seal at all exterior doors: 3/16 inch by 3/8 inch closed-cell PVC with adhesive back tape. Pemko 241, Reese, or equal.
- Q. Security Astragal: Full height of door; galvannealed steel; Pemko 3572, or equal.
- R. Mortised Drop Bottom: Fully mortised, plunger activated, automatic drop bottom, extruded tempered aluminum, clear anodized finish, grey sponge neoprene inserts, stainless steel fasteners suitable for hollow metal doors. Pemko 434PKL, Reese, or equal. Door Shoe Sweep: L-Shaped Aluminum with neoprene sweep insert and integral rain drip. Pemko 216 A PK; Reese, or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General: Contractor is responsible for the proper location, fit and operation of all finish hardware items under the appropriate headings. Install finish hardware according to the Drawings, Specifications, and finish hardware manufacturer's instruction. Place and adjust stops and or shim hinges to provide clearance for smoketight gaskets and to prevent doors from binding on stops or frames.
 1. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, wall and floor construction, and other conditions affecting performance.
 2. Notify Engineer of any discrepancies or conflicts between the door schedule, door types, drawings, and scheduled hardware. Proceed only after unsatisfactory conditions have been corrected and such discrepancies or conflicts have been resolved in writing.
- B. Make the right-hand door or right-hand reverse door the active leaf of a pair of doors unless indicated otherwise.
- C. Mounting Heights: Mount door hardware at the following heights unless specifically indicated otherwise on the Drawings.
 1. Locksets and latchsets: 38 inches above finish floor to center of lever.
 2. Deadbolts: Not more than 44 inches above finish floor to operating trim.
 3. Exit Devices: 40 inches above finish floor to center of touch bar.
- D. Fitting: Properly cut, drill, shape, reinforce, and otherwise fabricate items upon which finish hardware is to be installed according to templates, physical hardware, and finish hardware manufacturer's instructions to ensure proper attachment and function.
- E. Adjustment: Install all lock cylinders to accept keys with the teeth facing up. Adjust, shim, align all hardware to operate smoothly without binding or rubbing and so that self-closing and automatic closing doors will latch automatically.
- F. Doorstops/Holders/Keepers, Cane Bolts:
 1. Where physical conditions do not permit installation of the specified doorstop, holder, or keeper without creating a tripping hazard, provide a suitable item of comparable quality that will perform the intended function and can be installed such as a wall-mounted or surface overhead door-mounted device.
 2. Locate doorstops, holders, and keepers so doors will be held open in the maximum open position.
 3. For all outswinging pairs of doors that have cane, surface or flush bolts and do not have overhead door holders, provide exterior keepers to receive the cane, surface or flush bolts to hold doors open in the maximum open position.

3.02 ADJUSTING

- A. Adjust and check each operating item of door hardware and each door to ensure proper operation and function of every hardware component. Replace hardware components that cannot be adjusted to operate as intended.
- B. Adjust door closers to compensate for building pressures and operation of forced air mechanical equipment to comply with accessibility requirements.
- C. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
- D. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- E. Occupancy Adjustment: Approximately six months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.
- F. Defective Installation: Appearance, installation, attachment, and operation of finish hardware shall be subject to review by the Owner. Hardware that is scratched, broken, dirty, improperly painted, binds, or fails to function shall be replaced.

3.03 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation. Clean hardware components as necessary to restore proper finish.
- B. Provide protection during subsequent work progress to maintain conditions that ensure door hardware is in perfect working order and without damage or deterioration at the time of Substantial Completion.

3.04 HARDWARE SCHEDULE

- A. The Contractor is responsible for providing all finish hardware together with all components, accessories, and fasteners necessary for a complete and smooth operating installation.
- B. The door hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware, and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

- C. The supplier is responsible for handing and sizing all products as listed in the door hardware sets. Quantities listed are for each pair of doors, or for each single door.
- D. Only one manufacturer per product may be used on the project.
- E. Items in the following hardware schedule are referenced for standards of quality and utility.

Item	1st Manufacturer	2nd Manufacturer
Butts, hinges	Stanley	Hager, or equal
Locksets, latches	Schlage	Corbin
Cylinders, padlocks	Schlage	Corbin
Closers	LCN	Sargent, or equal
Exit devices	Von Duprin	Sargent, or equal
Silencers, stops, holders	Glynn-Johnson	Builder's Brass, or equal
Flush bolts, strikes	Ives, Glynn-Johnson	Builder's Brass, or equal
Door Shoe with Drip, Automatic Door Bottom with drip	Pemko	Reese, or equal
Thresholds	Pemko	Reese, or equal

F. Schedule of Hardware Groups:

1. Hardware Group 1 (Doors 1 and 2)

Each door shall have:

 - 1-1/2 pair butt hinges
 - 1 mortise exit device, ANSI function 09
 - 1 door closer
 - 1 kickplate
 - 1 dustproof strike
 - 1 door shoe with drip
 - 1 set weatherseal gasketing
 - 1 door stop/holder
 - 1 threshold
2. Hardware Group 2 (Door 3)

Each door shall have:

 - 1-1/2 pair butt hinges
 - 1 mortise latchset, ANSI function 01
 - 1 door closer
 - 1 kickplate
 - 1 set smokeseals
 - 1 kickdown door stop/hold open

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SECTION 09679

CHEMICAL RESISTANT EPOXY COATING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Chemical-resistant, pigmented epoxy-based resin seamless coating system with urethane topcoat for application on floor and wall surfaces of secondary containment spill areas with an integral cove base.

1.02 REFERENCES

A. ASTM International (ASTM):

1. C321 Standard Test Method for Bond Strength of Chemical-Resistant Mortars
2. D638 Standard Test Method for Tensile Properties of Plastic
3. D695 Standard Test Method for Compressive Properties of Rigid Plastics
4. D822/D822M Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings
5. D4060 Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
6. E162 Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source

1.03 SUBMITTALS

A. Submit the following:

1. Product Data: Fully describe all products proposed for use.
2. Samples: Finished flooring and standard line of colors and textures. Include a 3- by 3-inch square sample of the proposed system. Sample color, texture, and thickness shall be representative of overall appearance of finished system subject to normal tolerances.
3. Test Reports: Independent laboratory test results of specified physical characteristics.
4. Installer's Qualifications:
 - a. Material manufacturer's written approval of installer including verification of the coating manufacturer's training of the installer.
 - b. Provide a list of at least five similar installations completed by installer within last 2 years. Provide contact names of the facility owner's personnel knowledgeable of the installation with their current telephone numbers, along with background data on the coating system installed with the reference.
 - c. Installer's Jobsite Foreman's Qualifications

5. Submit a list of similar installations performed by the foreman in the last five (5) years.
6. Submit training record of the foreman by the coating manufacturer.
7. Written verification of SSPC certified concrete coating inspector for this project.
8. If admixtures or curing compounds are proposed for use, the Contractor shall submit a written statement to the Engineer that the use of the proposed admixtures and curing compounds will not interfere with the bond or cure of the specified coating system. The written statement shall be signed by the Contractor, coating applicator, and coating manufacturer.
9. System shall be in compliance with low VOC and/or the Indoor Air Quality requirements of Hawaii per State and Federal regulations.

1.04 QUALITY ASSURANCE

- A. Qualifications:
 1. The coating work shall be provided by a licensed specialty contractor who is engaged exclusively in the installation of chemical resistant epoxy coatings, has satisfactorily completed at least five similar installations within the last 2 years, and approved by the chemical resistant epoxy coating material manufacturer.
 2. The applicator's foreman shall have received trained by the coating manufacturer in the installation of similar coating systems.
 3. The applicator's foreman, or the applicator's QC personnel, or the chemical resistant coating manufacturer's representative shall be a SSPC certified concrete coating inspector. The SSPC certified concrete coating inspector shall visit the site as required to sign off on the surface preparation and coating installation.
 4. Qualified journeymen proficient in epoxy coating application shall perform all work.
- B. Comply with the manufacturer's recommendations and installation instructions of the coating material.

1.05 PRODUCT DELIVERY

- A. Deliver materials in manufacturer's labeled, unopened containers, clearly identified with the product type and batch number.
- B. Copies of Material Safety Data Sheets (MSDS) for all components shall be kept on site for review by the Engineer or other personnel.

1.06 PROJECT CONDITIONS

- A. Unless approved, in writing, by Contractor, coating applicator, and coating manufacturer, do not use admixtures in concrete slabs to receive epoxy coating, which might interfere with bond or cure of epoxy coating. Do not use concrete curing compounds; any concrete curing compound used to be removed in its entirety prior to epoxy coating applications.

- B. Maintain substrate temperature at 70°F for at least 48 hours before and after installation.
- C. Concrete surfaces on grade shall have been constructed with a vapor barrier to protect against the effects of vapor transmission and possible delamination of the system.
- D. All concrete surfaces (horizontal and vertical) to be coated shall comply with the coating manufacturer's MVER and concrete relative humidity requirements.

1.07 WARRANTY AND SPECIAL GUARANTEE

- A. The warranty for all products and work shall comply with the requirements of the Contractor's General Warranty and Guarantee described in the General Conditions and the Supplementary Conditions.
- B. Special Guarantee: In addition to the General Warranty and Guarantee, provide a written two (2) year special guarantee signed by the installer, material manufacturer, and Contractor covering the repair or replacement of the entire coating system to correct shrinkage cracks, bond failure, or surface deterioration resulting from causes other than abuse. Refer to Section 01700, Subsection 1.07.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Provide a coating system consisting of a bond coat, a liquid applied membrane, a base coat and two topping coats consisting of epoxy resins which cure to a hard, dense finish, having the physical characteristics specified in paragraph 2.03 of this Section.
- B. Manufacturers: Dex-O-Tex by Crossfield Products Corporation; Stonhard Stonchem 600 Epoxy System; Dur-A-Guard by Dur-A-Flex Inc.; Sherwin-Williams Protective and Marine Coatings General Polymers; or equal.
 - 1. Sole Source Responsibility: Obtain chemical resistant secondary containment system materials from a single manufacturer.

2.02 SYSTEM DESCRIPTION

- A. Products of the first named maker are used to establish the type and quality of product required. Equivalent products by other makers may be submitted for evaluation.
- B. System:
 - 1. Substrate preparation as recommended by manufacturer.
 - 2. Primer: Vapor Control Primer 200 or Vapor Control Primer 100 Type II
 - 3. Second coat: Cheminert SC Membrane
 - 4. Base coat: Posi-Tred CR; include aluminum oxide grit with floor coat.
 - 5. Top coat: Clear Posi-Tred CR (two coats).

2.03 PHYSICAL CHARACTERISTICS

- A. The primer shall have the following physical characteristics when fully cured:
 - 1. Adhesion, ASTM D4541: > 400 psi
 - 2. Compressive Strength, ASTM D695: 12,000 psi
 - 3. Tensile Strength, ASTM D638: 4,200 psi
 - 4. Tensile Elongation, ASTM D638: 2.7%
 - 5. Microbial Resistance, ASTM G21: Passes Rating 1
 - 6. Alkali resistance, ASTM D1308: resistant
 - 7. Moisture Vapor Emissivity, ASTM E96: 0.158 Perms
- B. The membrane shall have the following physical characteristics when fully cured:
 - 1. Compressive Strength, ASTM D695: 4,000 psi
 - 2. Tensile Strength, ASTM D638: 1,500 psi
 - 3. Tensile Elongation, ASTM D638: 96%
 - 4. Hardness, ASTM D2240, Shore D: 35 to 40
 - 5. Flammability, ASTM D635: Self Extinguishing, bonded to concrete
 - 6. Water absorption, ASTM D570: < 0.2%
 - 7. Tear Strength, ASTM D638: 120 lb/in
 - 8. Microbial Resistance, ASTM G21: Passes Rating 1
- C. The top coats shall have the following physical characteristics when fully cured:
 - 1. Surface Hardness, ASTM D2240, Shore D: 80 to 85
 - 2. Tensile strength, ASTM D638: 1,200 psi
 - 3. Flexibility, ASTM D1737, No loosening
 - 4. Adhesion, ASTM D4541, > 400 psi
 - 5. Adhesion (Crosshatch), ASTM D3359, 5B (no loosening)
 - 6. Thermal Shock Resistance, ASTM D1211: No failure
 - 7. Water Adsorption, MIL-D-3134, 7-day immersion: Nil
 - 8. Coefficient of Static Friction Rubber Shoe Surface, MIL-D-3134, (saltwater solution on surface): 0.95 static friction, 0.89 sliding friction
 - 9. Fire Resistance, ASTM E648, FTMS, NFPA 253, SBSIR 75-950, Critical Radiant Heat Flux: > 1.07 watts/cm
 - 10. Microbial Resistance, ASTM G21: Passes Rating 1.
- D. Chemical Resistance:
 - 1. Provide a coating system that shows little or no damage after 72-hour immersion in diesel fuel, gasolines, and similar chemicals.
 - 2. Provide a floor system that shows little or no damage from acids, alkalis, salts and solvents when tested in accordance with a test procedure similar to Crossfield Corporation Laboratories' test procedure using 36 different chemicals.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Allow concrete slabs to cure for at least 28 days before applying epoxy coating.
- B. Verify that concrete surfaces are dry. Test concrete with 4-hour rubber mat test.
- C. Examine substrates for defects that will adversely affect the execution and quality of the work.
- D. Do not start the work until all unsatisfactory conditions are corrected.

3.02 PREPARATION

- A. Remove the entire as-cast surface of the concrete substrate by shotblasting or sandblasting, if permitted by local regulations.
- B. Mask or protect adjacent surfaces not intended to receive coating.

3.03 APPLICATION SCHEDULE

- A. Provide secondary containments coatings for the following locations:

Room	Area Coated	Chemicals
Generator Room 202	All Concrete Surfaces below CMU Walls (including concrete wall starter curbs)	Diesel Fuel • Gasoline

3.04 INSTALLATION

- A. Install in strict conformance with the manufacturer's requirements.
- B. Fill joints and cracks as required by the manufacturer.
- C. Apply bond coat/negative side moisture vapor barrier at the rate of 7 mils. Use VaporControl Primer 200 if MVER is less than 10 lb/1,000 SF/ 24 hours or VaporControl Primer 100 Type II is less than or equal to 15.0 lb/1,000 SF/24 hours.
- D. Apply membrane coat at a minimum thickness of 30 mils to the floor and other horizontal surfaces. Apply two membrane coats at a rate of 8 to 10 mils per coat to vertical surfaces.
- E. Where specified apply epoxy intermediate coat over the membrane by trowel to a minimum thickness of 3/16 inch. Scree and finish surface to be level and flat within 1/16-inch when tested with an 8-foot straight edge.
- F. Apply first Posi-Tred CR coating at a thickness of 10 to 12 mils to the floor and other horizontal surfaces and at a minimum thickness of 6 mils to the vertical surfaces.

- G. Apply pre-engineered slip resistant aluminum oxide aggregate at a fine profile to the floor surface. It is not necessary to apply the slip resistant grit to pipe trenches, sumps or walls.
- H. Apply 12 mils DFT clear Posi-Tred CR topcoat.
- I. Provide a 1/4-inch radius at all inside corners.
- J. Coating installation shall be a first-class application with no runs.

3.05 PROTECTION

- A. Protect epoxy coating from damage by subsequent construction operations. Prohibit all foot and wheel traffic for at least seven (7) days. Cover horizontal and vertical surfaces with heavy-duty, nonstaining construction paper, taped in place for at least 7 days.
- B. Just before final acceptance, remove paper and wipe surfaces clean with damp cloths.

END OF SECTION

Lipoa Wastewater Pump Station

09679- 7

Chemical Resistant Epoxy Coating
Job No. WW19-02

SECTION 09900

PAINTING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. A painter's finish on all exterior and interior surfaces, except:
 - a. Integrally finished materials such as glass, concrete masonry units, concrete floors, laminated plastic, etc.
 - b. Factory finished items such as anodized aluminum, light fixtures, etc.
2. Painter's top coat or refinishing coat in a color to match adjacent surfaces on:
 - a. Miscellaneous mechanical and electrical items that are furnished with a factory finish that does not match the color of surrounding surfaces such as panelboards, air supply or return registers, fire extinguisher cabinets, hose reel cabinets, access doors and similar items that are located in finished walls or ceilings.
3. Prime coat paint on all exposed and concealed surfaces of sheet metal flashings prior to installation. See also Section 07600.

1.02 REFERENCES

- A. The Association for Materials Protection and Performance (AMPP) is maintaining the unique, original/legacy identifiers of published NACE and SSPC standards. All published NACE and SSPC standards will retain their current alpha numeric designation. When an SSPC or NACE document is revised, its date of publication will be updated, but its designation will not change. The document will have a new format containing an AMPP logo and copyright but will retain the legacy numbering system. New standards will utilize an AMPP designation. These standards of surface preparation can be found at AMPP.org.

1.03 SUBMITTALS

- A. Contractor Qualifications: Submit a list of at least five projects completed in the past five years where High-Performance Coatings, similar to those required for this project, were applied by the Specialty Painting Contractor proposed for this project.
- B. Product Data:
1. Submit complete technical data on all materials to be used on the project for review prior to ordering material. Include manufacturer's brand name and type of material for each coat of each system to be used.

2. The Contractor shall base his bid on using the products specified. If the products specified are not available in formulations that meet applicable Air Quality Management District regulations on maximum VOC levels, the Contractor shall submit products of equivalent quality and function that comply with regulations in effect at that time.
 3. If products manufactured by makers other than the first named product by the first named maker listed in Part 2 of this Section are submitted, submit supporting performance test results prepared by an independent paint testing laboratory for comparison with the performance of the first named product by the first named maker.
 4. If the Contractor's second submittal of a proposed equivalent material is not favorably reviewed the Contractor will be back-charged by the County for the cost of subsequent reviews.
- C. Manufacturer's Certification: That products furnished meet applicable Air Quality Management District regulations as to allowable VOC content for the place of application and use intended.
- D. Samples: For paints submit two 8-1/2 by 11-inch brush-outs of each paint system and each color on cardboard.

1.04 QUALITY ASSURANCE

- A. Contractor Qualifications: The Contractor is cautioned that the application of High Performance Architectural Coatings (HPAC) specified under this Section requires special skill, knowledge and equipment. In submitting his bid, the Contractor represents that he is skilled and experienced applying these coatings, has studied the material manufacturer's application requirements for the materials specified, agrees that the materials are suitable for intended use, and has included in his bid the cost of all labor and material required to achieve a successful coating system that meets the performance requirements of the contract documents.
- B. Regulatory Requirements: All work, material, procedures and practices under this Section shall conform with requirements of the Federal Standard 40 CFR on air quality control, and the requirements of the local Air Resources Board or Air Quality Management District having jurisdiction. Coatings or primers applied at locations other than the project site shall be done in accordance with local air quality regulations in effect at the place the coating is applied.

1.05 WARNING

- A. The Contractor is advised that the application, mixing and/or cleaning of paint and finishing material may be hazardous. The Contractor shall take all necessary precautions to ensure the safety of workers and property. This includes, but is not limited to, the use of NIOSH-approved respirators, and all

applicable personal protective equipment (PPE), for example, cloth coveralls, eye protection, gloves and head coverings.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver all materials in unopened containers with manufacturer's label. Label shall state VOC content.
- B. Store in assigned area. Maintain storage area clean and fire safe. Dispose of used rags and clean buckets daily. Store solvents in closed approved storage containers.
- C. Submerge solvent soaked rags in water.

1.07 PROJECT CONDITIONS

- A. Environmental Requirements:
 1. Provide ambient temperatures recommended by manufacturer of material to be applied.
 2. Provide adequate ventilation.
 3. Provide 40- to 50-foot candles of illumination on all surfaces in areas to be painted including floors, walls and ceiling that may not require painting.
 4. Use temporary dust barriers to close off areas being painted from areas where other work is being performed.

1.08 COLORS AND COLOR SAMPLES

- A. Before starting work, obtain color schedule and samples of colors selected for this project by the Architect. The colors selected may not be standard colors for the manufacturer whose materials are being used in which case custom colors shall be mixed to match the samples provided by the Architect. "Deep tone" highly pigmented accent colors may be selected for up to 10% of the area painted.
- B. Colors are to be factory or machine mixed, using light-fast colorants proportioned by accurate measurement into a proper tinting base. The color formula for each color shall be submitted to facilitate future color matching.
- C. Exterior deep tone colors are to be factory ground into the pigment for maximum color fastness.

PART 2 - PRODUCTS

2.01 MATERIALS - GENERAL

- A. Coatings used shall be "top of the line" and of the type recommended by the manufacturer for the intended use and substrate.
- B. Applicable Air Quality Management District regulations prohibit the manufacture, sale or application of Architectural Coatings and Specialty Coatings having greater than stipulated levels of volatile organic compounds.
- C. If the Contractor applies any coatings for which it has not submitted certificates indicating the VOC content and that the product complies with applicable Air Quality Management District regulations, or if it applies coatings that have been modified or thinned other than as recommended by the manufacturer, the Contractor shall be responsible for any fines, costs, remedies, or legal actions that may result.
- D. The Contractor shall not submit or use any material containing Trichlorethylene III because of its potential cancer-causing properties. If any of the materials specified in this Section contain trichlorethylene, they shall be considered deleted from this Specification.

2.02 SPECIALTY COATINGS: PRIMERS, STAINS, SEALERS AND CLEARS

- A. Products and makers listed establish type of material and level of quality. Equivalent products manufactured by Glidden Professional Paints, Sherwin-Williams, or equal may be submitted for review.
- B. Specialty Coatings: Coatings listed under this category include primers, sealers, stains and clear coatings. All products provided shall comply with the maximum allowable VOC limit assigned to that category of product by the Air Quality Management District having jurisdiction.
 - 1. LATEX UNIVERSAL RUST INHIBITING PRIMER
Primer for galvanized metal, shop primed steel, etc. Glidden Professional Acrylic Enamel Devflex 4020PF, Sherwin-Williams Pro Industrial Pro-Cryl Universal Acrylic Primer B66W01310, or equal.
 - 2. CHROMATE METAL PRIMER
N/A. Otherwise, Glidden Devguard 4160, Sherwin Williams DTM Acrylic Primer/Finish, or equal.
 - 3. EXTERIOR LATEX WOOD PRIMER
Latex primer for exterior wood. Glidden High Endurance Plus Primer, Sherwin-Williams Exterior Latex Wood Primer, or equal.
 - 4. ALKYD PHENOLIC GALVANIZED METAL PRIMER
Solvent thinned, alkyd phenolic galvanized metal primer. XIM 360 Gray NT Primer, Tnemec-Zinc Series 90-97, Glidden Devguard 4160, Sherwin-Williams Sherwin Williams DTM Acrylic Primer/Finish, or equal.

2.03 ARCHITECTURAL COATINGS

- A. Coatings listed under this category consist of decorative and protective coatings used to protect surfaces and provide color for buildings and other structures. Most paints and enamels fall under this category. All products used under this category must comply with a VOC limit of 350 unless otherwise noted.
- B. Products and makers listed establish type of material and level of quality. Equivalent products manufactured by Glidden, Sherwin-Williams, Devoe Coatings, or equal may be submitted for review.
 1. **HIGH GLOSS EXTERIOR LATEX ENAMEL**
100% acrylic latex exterior enamel with excellent color and gloss retention and excellent weather resistance. Devoe Coatings Interior/Exterior Waterborne Acrylic Gloss Enamel Devflex No. 4208QD, Sherwin-Williams SuperPaint Exterior Acrylic Latex High Gloss A85 Series Paint, or equal.
 2. **SEMI-GLOSS EXTERIOR LATEX ENAMEL**
100% acrylic latex (medium gloss) exterior house and trim enamel with excellent color and gloss retention and weather resistance. Glidden Premium Exterior Semi-Gloss Paint, Sherwin-Williams SuperPaint Exterior Latex Gloss A84 Series, or equal.
 3. **SEMI-GLOSS ACRYLIC LATEX INTERIOR ENAMEL**
Sherwin-Williams ProClassic® Interior Acrylic Latex Enamel Series, Glidden Diamond™ Interior Latex Semi-Gloss, or equal.
 4. **HIGH GLOSS INDUSTRIAL ENAMEL**
Sherwin-Williams Industrial Enamel B54 Series, Devoe Coatings Devguard 4308, or equal.

PART 3 - EXECUTION

3.01 CONDITION OF SURFACES TO BE PAINTED

- A. Examine areas to receive work of this Section. Make certain that surfaces are even, smooth, sound, clean, dry, and free from defects or substances that might affect application.
- B. Arrange for repairs or major cleaning as required. Starting work indicates acceptance of surfaces as satisfactory to achieve required result.

3.02 PREPARATION OF SURFACES

- A. Check that hardware, trim, plates, lighting fixtures and similar items have been removed before starting work; coordinate with work under sections installing such items. Check that equipment adjacent to walls shall be disconnected and

moved to permit wall surfaces to be painted before starting work under this Section.

- B. Wash metal surfaces with solvent or cleaner to remove dirt or grease and clean off rust or scale with wire brush or sandpaper.
- C. Bare or Shop Coated Steel: Remove rust and scale by wire brushing or sandblasting; wash with solvent or cleaner.
- D. Galvanized Steel: Etch with phosphoric solution such as Watco "Galvaprime", Endura "Galva-prep", or equal; flush surface clean with water and allow to dry.
- E. Prepare all surfaces in accordance with the more stringent of the coating material manufacturer's recommendations, other requirements in this paragraph 3.02 or referenced or applicable requirements for surface preparation in "Systems and Specifications", Volume 2, published by The Coatings Society, at SSPC.org and summarized below:
 1. SSPC-SP1 - Solvent Cleaning: Removal of all oil, grease, soil, drawing compound, cutting compound and other soluble contaminates from the surfaces with solvents and/or commercial cleaners by wiping, dipping, steam cleaning or vapor degreasing.
 2. SSPC-SP2 - Hand Tool Cleaning: Removal of all loose mill scale, rust, paint and other loose detrimental foreign matter by the use of non-powered hand tools.
 3. SSPC-SP3 - Power Tool Cleaning: Removal of all loose mill scale, rust, paint and other loose detrimental foreign matter by the use of power-operated portable tools.
 4. SSPC-SP5 – White Metal Blast Cleaning: Cleaning of a steel surface, previously painted or unpainted, to white metal condition through the use of abrasive blast media. The surface should, without magnification, be free of all visible oil, grease, dust dirt, mill scale, rust, coating, oxides, corrosion products, and other foreign matter.5.
SSPC- SP6 - Commercial Blast Cleaning: Removal of all oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products and other foreign matter by compressed air nozzle blasting, centrifugal wheels or other required methods. Remaining discoloration stains shall not exceed 33-1/3% of each square inch of surface.
 6. SSPC-SP7 - Brush-Off Blast Cleaning: Removal of all oil, grease, dirt, dust, loose-mill scale and loose paint by compressed air nozzle blasting. Centrifugal wheels or other required means.
 7. SSPC-SP11 – Power Tool Cleaning to Bare Metal: Removal of all stains from mill scale, rust or paint using power tools to take a surface to bare metal, while ensuring a minimum surface profile of 1 mil. Used in situations where abrasive blasting is not possible or feasible.
 8. SSPC-SP13 – Surface Preparation of Concrete: Preparation of concrete surfaces prior to the application of bonded coating or lining systems by the

removal of all surface contaminants including laitance, loose concrete and dust. Standard covers requirements for thermal, mechanical and chemical application methods.

- F. Dust all surfaces and wipe clean with a tack rag just prior to coating.

3.03 APPLICATION

- A. Apply all material in strict accordance with manufacturer's instructions. Apply first coat immediately after surface preparation.
- B. Do not apply coatings when temperature is below 55°F. Do not apply exterior coatings in damp or rainy weather.
- C. Brush out each coat to a uniform, even coating; lay material on in one direction and brush out at right angles. Special application techniques may be required for new coatings with low VOC content. Apply such coatings in strict accordance with manufacturer's detailed instructions. Allow material to dry 48 hours between coats unless longer period specified by manufacturer.
- D. Paint items and surfaces before installation that will be difficult or impossible to paint after installation.
- E. Apply not less than the number of coats specified. Apply additional coats if required for uniform coverage and full hiding. Apply finishes in their factory original consistencies. Do not thin unless specifically recommended by the manufacturer.
- F. Finish work shall be uniform in color, full coverage, smooth and free of sags and brush marks
- G. Do all cutting in to a sharp, true line. Repaint if necessary to correct over runs.
- H. Do not paint over Underwriters' labels, fusible links, sprinkler heads, or fire alarm devices.
- I. Paint access panels, electrical panels, air registers and similar items prior to installation to prevent edges from peeling or chipping when panels are removed.
- J. Repaint factory finished electrical panels, air registers, and other items to match adjacent painted surfaces.

3.04 PROTECTION, CLEANING AND COMPLETION

- A. Protect finish work by suitable covering or other method as job progresses.

- B. Remove paint spots from floors, glass and other surfaces, upon completion of work. Remove rubbish, empty containers and other accumulated materials from premises. Leave work in clean, orderly, acceptable condition.
 - C. Check work of this Section at completion of project. Touch-up or refinish marred or damaged surfaces. Replace glass damaged by operations under this Section. Leave entire area with finish free from imperfections.
- 3.05 PAINTING SYSTEMS AND SCHEDULE: ARCHITECTURAL COATING SYSTEMS
- A. See Notes on Drawings for additional location of surfaces to receive paint systems.
 - B. Characteristics of paint materials are described in Part 2 of this Section. First-named products are listed in this Schedule. Equivalent products by other manufacturers may be submitted for review in accordance with paragraphs 1.03 and 2.02 of this Section.
 - C. System "A": EXTERIOR/INTERIOR HIGH-GLOSS LATEX ENAMEL
 - 1. First Coat:
 - a. Shop primed ferrous metal: Touch-up with ALKYD RUST INHIBITING PRIMER. Devoe Coatings Multi-Purpose Tank and Structural Primer Devguard No. 4160.
 - b. Or, where shop prime coat is not suitable for overcoating with latex systems, re-prime entire surface with ALKYD PHENOLIC PRIMER. Devoe Coatings All Purpose Metal and Galvanized Primer Devguard No. 4160.
 - c. Unprimed ferrous metal: ALKYD RUST INHIBITING PRIMER.
 - d. Galvanized Metal: Pretreat with phosphate solution and prime with ALKYD PHENOLIC GALVANIZED METAL PRIMER. XIM 360 Gray NT Primer.
 - e. Wood: ALKYD EXTERIOR WOOD PRIMER. Sherwin-Williams Exterior Latex Wood Primer B42W08041.
 - 2. Second and Third Coats:
 - a. Two coats of HIGH GLOSS EXTERIOR LATEX ENAMEL. Devoe Coatings Interior-Exterior Waterborne Acrylic Gloss Enamel, Devflex No. 4208QD.
 - D. System "B": EXTERIOR/INTERIOR SEMI-GLOSS LATEX ENAMEL.
 - 1. First Coat:
 - a. Shop primed ferrous metal: Touch-up with ALKYD RUST INHIBITING PRIMER. Devoe Coatings Multi-Purpose Tank and Structural Primer Devguard No. 4160. Where shop prime coat is not suitable for overcoating with latex system, re-prime entire surface with ALKYD PHENOLIC PRIMER. Devoe Coatings Multi-Purpose Tank and Structural Primer Devguard No. 4160.

- b. Unprimed ferrous metal: ALKYD RUST INHIBITING PRIMER. Devoe Coatings Multi-Purpose Tank and Structural Primer Devguard No. 4160.
 - c. Galvanized Metal: Pretreat with phosphate solution in accordance with paragraph 3.02D and prime with ALKYD PHENOLIC GALVANIZED METAL PRIMER. XIM 360 Gray NT Primer.
 - d. Aluminum: Pretreat with metal etch and prime over aluminum. XIM 360 Gray NT Primer, Devoe Coatings Multi-Purpose Tank and Structural Primer Devguard No. 4160
2. Second and Third Coats: Two coats of SEMI-GLOSS EXTERIOR LATEX ENAMEL Sherwin-Williams SuperPaint Exterior Latex Gloss A84 Series.

E. System "C": SEMI-GLOSS ACRYLIC LATEX INTERIOR ENAMEL

- 1. First Coat:
 - a. On gypsum board: PVA SEALER. Glidden PVA Drywall Primer and Sealer.
 - b. Galvanized metal: Pretreat with phosphate solution in accordance with paragraph 3.02D and prime with ALKYD PHENOLIC GALVANIZED METAL PRIMER. XIM 360 Gray NT Primer, Devoe Coatings Multi-Purpose Tank and Structural Primer Devguard No. 4160.
- 2. Second and Third Coats: SEMI-GLOSS ACRYLIC INTERIOR ENAMEL: Sherwin-Williams ProClassic® Interior Acrylic Latex Enamel Series

H. System "F": HIGH GLOSS ALKYD INDUSTRIAL MAINTENANCE ENAMEL

- 1. Surface Preparation:
 - a. Steel: Brush-off blast cleaning to create a fine tooth. SSPC-SP7 or SSPC-SP6.
 - b. Galvanized Metal: Solvent cleaning followed by pretreatment with phosphate solution. See paragraph 3.02D in this Section.
- 2. First Coat:
 - a. Steel: ALKYD RUST INHIBITING PRIMER (touch up shop primed work). XIM 360 Gray NT Primer, Devoe Coatings Multi-Purpose Tank and Structural Primer Devguard No. 4180.
 - b. Galvanized Steel: ALKYD PHENOLIC GALVANIZED METAL PRIMER.
 - c. Aluminum: CHROMATE METAL PRIMER. XIM 360 Gray NT Primer, Devoe Coatings Multi-Purpose Tank and Structural Primer Devguard No. 4160.
- 3. Second and Third Coats: HIGH GLOSS ALKYD INDUSTRIAL ENAMEL applied at a surface dry film thickness of 6 mils per coat. Sherwin-Williams Pro Industrial Urethane Alkyd Enamel, Devoe Coatings Interior/Exterior Alkyd Gloss Enamel, Speed enamel No. 4318, or equal.

3.06 FINISH PAINT SCHEDULE

		✓ System " A" Door Frames – High Gloss Exterior Latex Enamel					
BUILDING EXTERIOR		✓ System " B" Doors – Semi-Gloss Exterior Latex Enamel					
Miscellaneous							
BUILDING INTERIOR							
Electrical Room			✓				
Generator Room			✓				
Generator Room - Floor and Starter Curb							✓

END OF SECTION

SECTION 09920

GRAFFITI RESISTANT COATING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. A clear graffiti resistant coating application to all exposed above grade exterior and interior concrete, precast concrete, and concrete unit masonry surfaces of structures that enclose space for human occupancy or for machinery, equipment, or storage to protect from graffiti, stains from pollutants, and other unwanted surface markings.

1.02 SUBMITTALS

A. Submit the following:

1. Product Data: Fully describe all products proposed for use. Include Material Information Sheet for all products.
2. Manufacturer's 10-year warranty for Graffiti Resistant Coating.

1.03 QUALITY ASSURANCE

A. Contractor Qualifications: In submitting his bid, the Contractor represents that he is skilled and experienced applying these coatings, has studied the material manufacturer's application requirements for the materials specified, agrees that the materials is suitable for intended use, and has included in his bid the coat of all labor and material required to achieve a successful coating system meeting the performance requirements of the contract documents.

B. Regulatory Requirements: All work, material, procedures and practices under this Section shall conform with requirements of the Federal Standard 40 CFR on air quality control, and the requirements of the local Air Resources Board or Air Quality Management District having jurisdiction.

C. Trade Association Recommendations:

1. Comply with recommendations on waterproofing/anti-graffiti coatings contained in the "Masonry Design Manual" published by the Masonry Industry Advancement Committee.
2. Comply with the Portland Cement Association recommendations for waterproofing/anti-graffiti coating architectural concrete.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver material in labeled unopened containers.

B. Store all material on raised platforms protected from moisture and from contamination by dirt, mud or other foreign material.

1.05 COORDINATION

- A. Coordinate with other trades whose work may be damaged by coating application.
- B. Protect glass and other finished surfaces with polyethylene sheeting taped in place.

1.06 SPECIAL GUARANTEE

- A. Provide a signed ten (10) year Special Guarantee in accordance with Section 01700, signed by the coating manufacturer, applicator and Contractor against coating's failure to withstand multiple graffiti removals on the treated masonry or concrete.

PART 2 - PRODUCTS

2.01 GRAFFITI RESISTANT COATING

- A. Material:
 - 1. Water-based urethane formulation non-sacrificial graffiti barrier for lightweight concrete block and architectural concrete.
 - 2. Non-yellowing, fast drying.
 - 3. Meet requirements of Air Quality Management District having jurisdiction.
 - 4. Retards the growth of mold, mildew, and algae.
 - 5. Apply at the rate and number of coats recommended by the manufacturer for the density, porosity and texture of concrete and/or concrete block used, and to meet warranty requirements.
 - 6. Manufacturer: Visual Pollution Technologies Inc. (VPT) "Crystal Clear"; Rainguard International "Vandguard"; Sculpt Nouveau "Shields Up"; or equal.

PART 3 - EXECUTION

3.01 APPLICATION OF GRAFFITI RESISTANT COATING

- A. Apply sealer after concrete and masonry has cured at least 30 days, and after any biocides of pigmented paints, coatings, and any integrally-colored stucco colorant additives are released.
- B. Prior to applying sealer remove all efflorescence and clean down all masonry and architectural concrete by scrubbing with water and masonry or concrete cleaner and bristle brushes. Do not use muriatic acid or high-pressure water cleaning. Allow to fully dry.
- C. Inspect surface for cracks. Rout out all cracks 5 mils and wider and fill with a high performance joint sealant having a 20-year life expectancy and recommended by the graffiti resistant coating manufacturer for use on

- substrates to be coated with this graffiti resistant coating. Perform joint sealant work in accordance with Section 07900.
- D. Test Panel: Apply clear sealer onto a MANDATORY mock wall or test panel. Test the wall or an actual surface area to determine acceptable color, surface porosity, application rates and methods before starting general application.
 - E. Spray-Apply Coating: Recommended for rough or textured surfaces (use brush and roller at smooth surfaces). Use airless spray equipment with recirculating type pump and perforated T bar applicator recommended by the coating manufacturer. DO NOT USE pressure pot spray equipment. Do not allow the coating to pool on the substrate surface.
 - F. Protect surfaces, which are not to be coated. Cover all glass, anodized aluminum, overhead coiling doors, metal doors, etc. with polyethylene sheeting; continuously seal all edges with tape.
 - G. Apply coating material in accordance with manufacturer's instructions. Apply in a fine mist, cross-hatched pattern to build up the wet coating. As soon as the entire surface has been coated, immediately repeat process with a second pass.
 - 1. Rate of Application: Coverage as recommended by the manufacturer for porous concrete block, precast concrete, painted surfaces, etc.
 - 2. Number of Coats: As per manufacturer's warranty requirements for substrate conditions.

END OF SECTION

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SECTION 09960
HIGH PERFORMANCE COATINGS

PART 1 - GENERAL

1.01 SCOPE

- A. Section 09960 provides the requirements for; coating systems, surface preparation, coating application, and quality assurance/quality control relative to the equipment, structures listed in the Finish Schedule.
- B. Unless specified elsewhere, or indicated on the Finish Schedule/Project Drawings, the following shall not be coated:
 - 1. Metal completely embedded in concrete (except aluminum).
 - 2. Piping buried in ground or encased in concrete.
 - 3. Galvanized metal.
 - 4. Chain link fence and fence gates.
 - 5. Rubber.
 - 6. Plastic pipe, including polyvinyl chloride, polyethylene, and polypropylene piping.
 - 7. Stainless steel.
 - 8. Bronze, brass.
 - 9. Nameplates and grease fittings.
 - 10. Factory finished electrical panels.
 - 11. Factory fusion-bonded epoxy coated items.
 - 12. Aluminum or galvanized ductwork enclosed inside furred ceiling spaces.
 - 13. Aluminum handrail and aluminum guardrail.
 - 14. Fiberglass.
 - 15. Electrical conduit.
 - 16. Copper pipe.

1.02 DEFINITIONS

- A. Abrasive: Material used for blast-cleaning, such as sand, grit or shot.
- B. Abrasive Blast Cleaning: Cleaning/surface preparation by abrasive propelled at high speed.
- C. Anchor Pattern: Profile or texture of prepared surface(s).
- D. ANSI: American National Standards Institute.
- E. ASTM: American Society for Testing and Materials International.

- F. **Bug Holes**: Small cavities, usually not exceeding 15 mm in diameter, resulting from entrapment of air bubbles in the surface of formed concrete during placement and compaction.
- G. **Coating/Lining Thickness**: The total thickness of primer, intermediate and/or finish coats.
- H. **Dewpoint**: Temperature of a given air/water vapor mixture at which condensation starts.
- I. **Dry Film Thickness (DFT)**: Depth of cured film, usually expressed in mils (0.001-inch). Use this definition as opposed to existing definition.
- J. **Drying Time**: Time interval between application and curing of material.
- K. **Dry to Recoat**: Time interval between application of material and ability to receive next coat.
- L. **Dry to Touch**: Time interval between application of material and ability to touch lightly without damage.
- M. **Feather Edging**: Reducing the thickness of the edge of paint.
- N. **Feathering**: Operation of tapering off the edge of a point with a comparatively dry brush.
- O. **Field Coat**: The application or the completion of application of the coating system after installation of the surface at the site of the work.
- P. **Hold Point**: A defined point, specified in Section 09960, at which work shall be halted for inspection.
- Q. **Holiday**: A discontinuity, skip, or void in coating or coating system film that exposes the underlying substrate.
- R. **Honeycomb**: Segregated condition of hardened concrete due to non-consolidation.
- S. **ICRI**: International Concrete Repair Institute.
- T. **Incompatibility**: Inability of a coating to perform well over another coating because of bleeding, poor bonding, or lifting of old coating; inability of a coating to perform well on a substrate.
- U. **Laitance**: A layer of weak, non-durable concrete containing cement fine that is brought to the surface through bleed water as a result of concrete finishing / over-finishing.

- V. Mil: 0.001-inch.
- W. NACE International: National Association of Corrosion Engineers-International.
- X. Pinhole: A small diameter discontinuity in a coating or coating system film that is typically created by outgassing of air from a void in a concrete substrate resulting in exposure of the substrate or a void between coats.
- Y. Pot Life: Time interval after mixing of components during which the coating can be satisfactorily applied.
- Z. Resurfacer/Resurfacing Material: A layer of cementitious and/or resin-based material used to fill or otherwise restore surface continuity to worn or damaged concrete surfaces.
- AA. Shelf Life: Maximum storage time for which a material may be stored without losing its usefulness.
- BB. Shop Coat: One or more coats applied in a shop or plant prior to shipment to the site of the work, where the field or finishing coat is applied.
- CC. Spreading Rate: Surface area covered by a unit volume of paint at a specific film thickness.
- DD. SSPC: The Society for Protective Coatings.
- EE. Stripe Coat: A separate coat of paint applied to all weld seems, pits, nuts/bolts/washers and edges by brush. This coat shall not be applied until any previous coat(s) have cured and once applied, shall be allowed to cure prior to the application of the subsequent coat(s).
- FF. Surface Saturated Dry (SSD): Refers to concrete surface condition where the surface is saturated (damp) without the presence of standing water.
- GG. Tie Coat: An intermediate coat used to bond different types of coatings. Coatings used to improve the adhesion of a succeeding coat.
- HH. Touch-Up Painting: The application of paint on areas of painted surfaces to repair marks, scratches, and areas where the coating has deteriorated to restore the coating film to an unbroken condition.
- II. TPC: Technical Practice Committee.
- JJ. Volatile Organic Compound (VOC) Content: The portion of the coating that is a compound of carbon, is photo chemically reactive, and evaporates during drying or curing, expressed in grams per liter (g/l) or pounds per gallon (lb./gal).

KK. Immersion: Refers to a service condition in which the substrate is below the waterline or submerged in water or wastewater at least intermittently if not constantly.

LL. Weld Spatter: Beads of metal scattered near seam during welding.

MM. Wet Film Thickness (WFT): The primer or coating film's thickness immediately following application. Wet film thickness is measured in mils or thousandths of an inch (0.001-inch) and is abbreviated WFT.

1.03 REFERENCES

- A. Section 09960 contains various guide documents, technology reports, and other industry standards relative to surface preparation, coating application, and testing methods. They are a part of Section 09960 as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under Section 09960 as if referenced directly. In the event of conflict between the requirements of Section 09960 and those of the listed documents, the requirements of Section 09960 shall prevail.
- B. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Invitation to Bid. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued, or replaced.
- C. STANDARDS AND REFERENCES:
 1. American National Standards Institute (ANSI):
 - a. ANSI/NSF 61: Drinking Water System Components Health Effects
 2. ASTM International:
 - a. ASTM D16-11a: Standard Terminology for Paint, Related Coatings, Materials, and Applications
 - b. ASTM D3960: Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings
 - c. ASTM D4262: Standard Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces
 - d. ASTM D4263: Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method

- e. ASTM D4414: Standard Practice for Measurement of Wet Film Thickness by Notch Gages
 - f. ASTM D4417: Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel
 - g. ASTM D4541: Standard Test Methods for Pull-Off Strength of Coatings on Metal Substrates Using Portable Adhesion Testers
 - h. ASTM D4787: Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates
 - i. ASTM D5162: Standard Practice for Discontinuity (Holiday) Testing of Nonconductive Protective Coating on Metallic Substrates
 - j. ASTM D7234: Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Adhesion Testers
 - k. ASTM E337: Standard Test Method for Measuring Humidity with a Psychrometer
 - l. ASTM F1869: Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
3. Federal:
- a. FS 595b: Federal Standard Colors
 - b. International Concrete Repair Institute (ICRI):
 - 1) ICRI 310.2: Guideline for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays
 - c. National Association of Corrosion Engineers International (NACE):
 - 1) NACE Standard SP0188: Standard Recommended Practice – Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates
 - 2) NACE Standard RP0288: Standard Recommended Practice, Inspection of Linings on Steel and Concrete
 - 3) NACE Standard SP0892: Standard Recommended Practice, Linings Over Concrete in Immersion Service
 - 4) NACE Publication TPC2 Coatings and Linings for Immersion Service
 - d. National Association of Pipe Fabricators (NAPF):
 - 1) NAPF 500-03: Surface Preparation Standard for Ductile Iron Pipe and Fittings in Exposed Locations Receiving Special External Coatings and/or Special Internal Linings
 - e. Occupational Safety and Health Administration (OSHA):
 - 1) OSHA Title 29, Part 1926: Safety and Health Standards for Construction

- f. Society for Protective Coatings (SSPC):
- 1) SSPC-PA COM: Paint Application Specifications and Guides (Commentary)
 - 2) SSPC-AB 1: Mineral and Slag Abrasives
 - 3) SSPC-PA 1: Shop, Field, and Maintenance Painting of Steel
 - 4) SSPC-PA 2, Level 3: Measurement of Dry Coating Thickness with Magnetic Gages
 - 5) SSPC-PA 9: Measurement of Dry Coating Thickness on Cementitious Substrates Using Ultrasonic Gages
 - 6) SSPC Technology Guide 6: Guide for Containing Debris Generated During Paint Removal Operations
 - 7) SSPC Technology Guide 7: Guide to the Disposal of Lead-Contaminated Surface Preparation Debris
 - 8) SSPC-PA Guide 10: A Guide to Safety and Health Requirements for Industrial Painting Projects
 - 9) SSPC-PA Guide 11: Protecting Edges, Crevices, and Irregular Steel Surfaces by Stripe Coating
 - 10) SSPC Technology Guide 12: Guide for Illumination of Industrial Painting Projects
 - 11) SSPC-PA Guide 15: Field Methods for Retrieval and Analysis of Soluble Salts on Steel and other Non-Porous Substrates
 - 12) SSPC-PA Guide 17: Procedure for Determining Conformance to Steel Profile/Surface Roughness/Peak Count Requirements
 - 13) SSPC-PA Guide 19: Guide to Selecting Coatings for Use Over Galvanized Steel Substrates
 - 14) SSPC SP1: Solvent Cleaning
 - 15) SSPC SP2: Hand Tool Cleaning
 - 16) SSPC SP3: Power Tool Cleaning
 - 17) SSPC SP5: White Metal Blast Cleaning
 - 18) SSPC SP6: Commercial Blast Cleaning
 - 19) SSPC SP7: Brush-Off Blast Cleaning
 - 20) SSPC SP10: Near-White Blast Cleaning
 - 21) SSPC SP11: Power Tool Cleaning to Bare Metal
 - 22) SSPC SP 13: Surface Preparation of Concrete
 - 23) SSPC SP 14: Industrial Blast Cleaning
 - 24) SSPC SP 15: Commercial Grade Power Tool Cleaning
 - 25) SSPC SP 16: Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals
 - 26) SSPC-TR 2/NACE 6G198: Wet Abrasive Blast Cleaning
 - 27) SSPC-TR3/NACE 6A192: Dehumidification and Temperature Control During Surface Preparation, Application, and Curing for Coatings/Linings of Steel Tanks, Vessels, and Other Enclosed Spaces
 - 28) SSPC-TU-3: Overcoating

- 29) SSPC-VIS 1: Visual Standard for Abrasive Blast Cleaned Steel
- 30) SSPC-VIS 3: Visual Standard for Power and Hand – Tool Cleaned Steel
- 31) SSPC-VIS 4: Visual Standards (Waterjetting)
- 32) SSPC-VIS 5: Visual Standards (Wet Abrasive Blast Cleaning)
- 33) SSPC-WJ 1,2,3,4: Water Jetting Surface Preparation Standards

1.04 SUBMITTALS

A. Provide in accordance with Section 01300:

1. A copy of the Finish Schedule specified in paragraph 3.04 of this section denoting the specific products and specific manufacturers for each item (structure, equipment, or substrate) indicated on the Finish Schedule. Include manufacturer's brand name, product name, and designation number for each coat of each system to be used.
 - a. A color card or fan deck for each manufacturer and each coating product. For products to be applied to concrete, submit samples of each coating system on a 3-inch x 3-inch x 1-inch concrete or mortar block. Each block shall be completely coated at the specified thickness over one 3-inch x 3-inch surface with the applicable coating system.
2. Prior to ordering material, submit a complete schedule of coatings to be applied including location and Owner approved colors for each location (structure, equipment, substrate).
3. Current printed recommendations and product data sheets for coatings/coating systems including:
 - a. Volatile organic compound (VOC) data
 - b. Storage requirements
 - c. Surface preparation recommendations.
 - d. Primer type, where required.
 - e. Maximum dry and wet mil thickness per coat.
 - f. Minimum and maximum curing time between coats, including atmospheric conditions for each.
 - g. Curing time before submergence in liquid.
 - h. Thinners/solvents for reduction and cleaning
 - i. Ventilation requirements.
 - j. Minimum and maximum atmospheric application conditions
 - k. Allowable application methods.
 - l. Maximum allowable moisture content (concrete substrates).
 - m. Maximum shelf life.
4. Manufacturer's Certification that the submitted coatings meet applicable Air Quality Management District regulations as to allowable volatile organic compound (VOC) content for the place of application and use intended.

5. Submit qualifications for Q.C. personnel to be provided on site by the Contractor. This will include the inspector's NACE and/or SSPC Certification numbers for the certifications requested in paragraph 1.05.E.2. of this Section.
6. Material Safety Data Sheets (MSDS) for all materials to be delivered to the job site, including coating system materials, solvents, and abrasive blast media.
7. Detailed, written instructions for coating system treatment and graphic details for coating system terminations in the structures to be coated including pipe penetrations, metal embedment, gate frames, and other terminations to be determined from the contract drawings. This information shall also include detail treatment for coating system at joints in concrete.
8. A minimum of five project references, including current contact name, address, and telephone number where the Contractor has successfully performed similar coating work within the past five years.
9. A minimum of five project references, including current contact name, address, and telephone number where the submitted materials have been successfully applied, in similar exposures, within the past five years. This submittal is only required if products not listed in Section 09960 are submitted.
10. A letter from the coating manufacturers selected and approved for the project that verifies that the applicator meets the quality assurance requirements of 1.05.C. of Section 09960 including application personnel training requirements.
11. The Contractor shall include in this submittal the end date for field coating application for all equipment, machinery, and piping to ensure that the maximum recoat time for the shop applied primers will not be exceeded when field applied coatings are installed.
12. Submit a list and description of any and all miscellaneous surfaces for which there is a question about what standard coating system to apply as part of the work covered by Section 09960.

1.05 QUALITY ASSURANCE

A. ENVIRONMENTAL REGULATORY REQUIREMENTS:

1. All work, material, procedures, and practices under Section 09960 shall conform with requirements of the Department of Health Clean Air Branch. Prime or finish coat painting done in locations other than the project site shall be in accordance with air quality regulations in effect at the place the coating is applied.
2. If the Contractor applies coatings that have been modified or thinned other than as recommended or approved by manufacturer, the Contractor shall be responsible for any fines, costs, remedies or legal actions that may result.

3. Surface preparation activities that result in the generation of airborne emissions shall be performed in accordance with applicable Federal, State, County, and ordinances. The Contractor shall be responsible for securing any and all licenses and permits required, at no additional cost to the County.
4. All debris (liquid or solid) generated from surface preparation or coating activities shall be disposed offsite in accordance with applicable Federal, State, County, and ordinances. The Contractor shall be responsible for all required testing, licenses, permits, and fees, at no additional cost to the County.

B. COATING MANUFACTURER'S QUALIFICATIONS:

1. All protective coatings furnished under Section 09960 shall:
 - a. Be of a manufacturer who has been regularly engaged in the manufacture of protective coatings with a minimum of 10 years of successful experience.
 - b. Demonstrate to the satisfaction of the Construction Manager successful performance on comparable projects.

C. COATING APPLICATORS QUALIFICATIONS:

1. The application company or entity must demonstrate with written references as required in 1.04.A.7. and 8. a minimum of five (5) years of practical experience in the application of the specified coatings and the successful completion of a minimum of five (5) projects of similar size and complexity within the last three (3) years. This must be verified in writing by the selected coating system manufacturer.
2. The application company or entity must possess a valid State of Hawaii (C-33, C-55 or A) license as required for the application of coatings.
3. For the application company's or entity's personnel: employ only those persons on the project trained in the application of the specified protective coatings. Written confirmation of this must be provided by the approved coating systems manufacturer.

D. COATING PRECONSTRUCTION MEETING:

1. The Contractor shall attend a coating preconstruction meeting prior to commencing any surface preparation or coating application work. Parties attending the meeting shall include the General Contractor, Construction Manager, Coating Applicator, the coating applicator's Q.C. lead person, and a representative of the Coating Manufacturer. The following items shall be reviewed and discussed at the preconstruction meeting.
 - a. Schedule.
 - b. Environmental requirements.

- c. Surfaces to be coated, and protection of surfaces not scheduled to be coated.
- d. Surface preparation.
- e. Colors.
- f. Application.
- g. Coating repair.
- h. Field quality control.
- i. Housekeeping.
- j. Protection of coating systems.
- k. One-year inspection.
- l. Coordination with other trades/work activities/schedules.
- m. Manufacturer's ongoing technical assistance.

E. QUALITY CONTROL REQUIREMENTS:

- 1. The Contractor is responsible for ensuring that the surface preparation and coating activities meet/exceed the requirements of this specification. Inspections by the Construction Manager, or a representative of the coating manufacturer, will not relieve or limit the Contractor's responsibilities.
- 2. The specified quality control tasks shall be performed by an individual who has been properly trained and has a minimum of 5 years of experience. The contractor shall provide the Construction Manager documentation indicating that the individual designated to perform quality control has received training similar to NACE CIP Level 3, SSPC PCI Level 2, and, has a minimum of 5 years field experience.
- 3. The Contractor's methods shall conform to requirements of this specification and the standards referenced in paragraph 1.03.B. Changes in the coating system installation requirements will be allowed only with the written authorization of the Construction Manager before work commences.
- 4. Contaminated, outdated, diluted materials, and/or materials from previously opened containers shall not be used.
- 5. For repairs, the contractor shall provide the same products, or products recommended by the coating manufacturer, as used for the original coating.
- 6. The Contractor shall identify the points of access for inspection by the Construction Manager. The contractor shall provide ventilation, ingress and egress, and other means necessary for the County's personnel to safely access the work areas.
- 7. The Contractor shall conduct the work so that the coating system is installed as specified and shall inspect the work continually to ensure that the coating system is installed as specified. Coating system work that does not conform to the specifications or is otherwise not acceptable shall be corrected in accordance with the coating manufacturer's written procedures.

8. The Contractor shall prepare and submit daily reports for each day surface preparation and coating work is conducted at the site. The daily reports shall be submitted to the Construction Manager by 1:00 PM the following workday. The daily reports shall include the following:
- a. Number of employees on site (broken down by craft).
 - b. Start and finish time of work shift.
 - c. Climatic conditions at 4-hour intervals (i.e., partly cloudy, air temperature 78°F, relative humidity 63%, dew point 68° F, and WNW wind @ 4 mph).
 - d. Major equipment on site regardless of utilization (i.e., trailers, air compressors, generators, spray pumps, scaffolding, aerial lifts, pressure washers, and sandblast pots).
 - e. Inventory of coatings, solvents and abrasive media stored on site including information relative to deliveries received each day.
 - f. Summary of work performed to include:
 - 1) Substrates / structures prepared (size, quantity, and location).
 - 2) Surface preparation methods including materials consumed and equipment utilized.
 - 3) Substrates/structures coated (size, quantity, and location).
 - 4) Mixing method and time mixed (coating materials).
 - 5) Induction time, pot life, and application start time.
 - 6) Coating application methods including equipment utilized.
 - 7) Application finish time.
 - 8) Coating materials consumed (sequencing, product name, batch number(s) and manufacture date).
 - 9) Problems encountered (i.e., equipment malfunctions or disruption/interference by other trades).
 - 10) Accidents or near misses.
 - 11) Quality control testing results indicated in paragraph 1.05-E.9.
9. The following quality control tests shall be considered mandatory unless noted elsewhere in Section 09960:

TEST REQUIREMENT	REFERENCE STANDARD	INTERVAL/FREQUENCY
Measure and Record Ambient and Surface Temperatures	N/A	During coating application and initial cure every 3 hours.
Measure and Record Relative Humidity and Dew Point	ASTM D 337	During coating application and initial cure every 3 hours.
Abrasive Cleanliness	SSPC AB-1 SSPC AB-2 ASTM D 4940	Each day abrasive blasting is performed immediately prior to start of abrasive blasting.
Compressed Air Cleanliness	ASTM D 4285	Each day compressed air is utilized for abrasive blasting, paint application, or to remove surface

TEST REQUIREMENT	REFERENCE STANDARD	INTERVAL/FREQUENCY
		contamination immediately prior to any of the indicated operations.
Determining Level of Cleanliness (substrate condition after the specified surface preparation has been completed)	SSPC – VIS 1 SSPC - VIS 3 SSPC - VIS 4/NACE VIS 7 SSPC - VIS 5/NACE VIS 9 SSPC - SP 1 SSPC - SP 2 SSPC - SP 3 SSPC - SP 5/NACE No. 1 SSPC - SP 6/NACE No. 3 SSPC - SP 7/NACE No. 4 SSPC - SP 10/NACE No. 2 SSPC - SP 11 SSPC - SP 13/NACE No. 6 SSPC - SP 14/NACE No. 8 SSPC - SP 15 SSPC - SP 16 SSPC - WJ 1, 2, 3, 4	Each day surface preparation is performed immediately prior to coating application.
Levels of Soluble Salt Contamination (steel and other nonporous substrates)	SSPC Technology Guide 15	Each day coating application is performed immediately prior to coating application
Surface pH (concrete or metal)	ASTM D 4262 (use 6.1 and 6.2 for metal)	Each day coating application is performed immediately prior to coating application.
Measurement of Surface Profile (metal substrates)	ASTM D 4417	Each day surface preparation is performed upon completion of shift or task.
Measurement of Surface Profile (concrete substrates)	ASTM D 7682	Each day surface preparation is performed upon completion of shift or task.
Comparison of Surface Profile (concrete substrates)	ICRI 310.2	Each day surface preparation is performed upon completion of shift or task.
Moisture in Concrete (plastic sheet method)	ASTM D 4263	Upon completion of surface preparation whenever climatic conditions substantially change.
Relative Humidity (slabs/concrete floors)	ASTM F 2170	As recommended by coating/lining manufacturer.

TEST REQUIREMENT	REFERENCE STANDARD	INTERVAL/FREQUENCY
Measure and Record Material Temperatures (all components)	N/A	Each day coating application is performed immediately prior to coating application.
Wet Film Thickness	ASTM D 4414	Each day coating application is performed hourly during coating application.

TEST REQUIREMENT	REFERENCE STANDARD	INTERVAL/FREQUENCY
Dry Film Thickness (ferrous metal/magnetic substrates)	SSPC-PA 2	After coating has properly cured. After each layer (component) of the specified coating system,
Dry Film Thickness (non-ferrous metal substrates)	ASTM D 1400	After coating has properly cured. After each layer (component) of the specified coating system.
Dry Film Thickness (cementitious substrates)	SSPC-PA 9	After coating has properly cured. After each layer (component) of the specified coating system.
Dry Film Thickness (destructive method – all substrates)	ASTM D 4138	Whenever verification as to the accuracy of other methods is deemed necessary.
Holiday Detection (conductive substrates)	NACE SPO 188	After coating <u>system</u> has properly cured. Once on entire surface and as necessary over repaired areas to verify effectiveness of the repair(s).
Holiday Detection (metal substrates)	ASTM D 5162	After coating <u>system</u> has properly cured. Once on entire surface and as necessary over repaired areas to verify effectiveness of the repair(s).
Adhesion Testing (metal substrates)	ASTM D 4541	After coating <u>system</u> has properly cured. Number of tests proportionate to surface area.
Adhesion Testing (concrete substrates)	ASTM D 7234	After coating <u>system</u> has properly cured. Number of tests proportionate to surface area.

TEST REQUIREMENT	REFERENCE STANDARD	INTERVAL/FREQUENCY
Final Cure (solvent rub – organic coatings)	ASTM D 5402	After coating <u>system</u> has been cured per manufacturer's published recommendations.

10. Acceptance criteria for each Quality Control test shall be as indicated on the Coating Detail Sheets, the manufacturer's published data, or elsewhere in this specification, whichever is more stringent.

F. MANDATORY HOLD POINT INSPECTIONS:

1. Hold Point Inspections shall be performed in the Construction Manager's presence. The contractor shall provide the Construction Manager a minimum two (2) hours' notice prior to performing a Hold Point Inspection.
2. Hold Point Inspections shall be performed as follows for each structure scheduled for coating application:
 - a. Prior to surface preparation to determine; if the environmental or site conditions would be detrimental to surface preparation/coating application, and if the substrate is void of detrimental defects/contamination.
 - b. Upon completion of the specified surface preparation (concrete and non-ferrous substrates) or upon completion of the first full production day of surface preparation (ferrous substrates), to ensure that the specified level of cleanliness and surface profile have been achieved.
 - c. Prior to application of the filler-surfacer (concrete)/prime coat to ensure that suitable ambient conditions (as required by Section 09960 or the coatings manufacturer) exist and will be maintained. This Hold Point Inspection may be concurrently performed with Hold Point Inspection "b" provided that remedial surface preparation is not required and that the contractor is prepared to immediately apply the filler-surfacer/primer.
 - d. Upon completion of each coating system component to; ensure that no visual coating defects such as runs, sags, voids, holidays, and embedment of foreign matter are present, and to ensure that the specified dry film thickness has been achieved.
 - e. Upon final cure of the complete coating system to; identify visual coating defects, measure coating system dry film thickness, perform cure evaluation testing, perform holiday detection testing, and perform adhesion testing. Due to the nature and complexity of the specific testing requirements this Hold Point may encompass between several hours to several days.

- f. Upon completion of remedial repairs (final inspection). Should the coating defects be identified at the final cure Hold Point Inspection, all previously stated Hold Points will be applicable during the coating repair process after which a final inspection will be performed. Retesting will be required for the repaired areas at no additional cost to the County.
3. The Contractor shall indicate the execution and nature of each Hold Point Inspection of the daily report.
4. The Construction Manager will acknowledge participation at each individual Hold Point on a Contractor prepared document appended to the daily report. The document must include a section wherein the Construction Manager may indicate exceptions or qualifications. It shall be the Contractor's responsibility to ensure that the Hold Point Inspection is acknowledged by the Construction Manager.
5. Failure to comply with any or all of the Hold Point Inspection requirements may result in the rejection of all subsequent work.
6. Hold Point Inspections may only be waived by written authorization from the Construction Manager.

1.06 ILLUMINATION

- A. Provide the following minimum illumination during all phases of work:
 1. General work area: 25-Foot Candles
 2. Surface preparation and coating application: 30-Foot Candles
 3. Inspection: 50-Foot Candles

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver all coating materials in unopened containers with manufacturer's label, which must include name, batch number, manufacturer date, shelf life, and VOC content.
- B. Store in an assigned area onsite with concurrence from the coating manufacturers. Maintain storage area clean and fire safe. Dispose of used rags, thinner and buckets daily. Store solvents in closed approved storage containers.

1.08 WARNINGS

- A. Be advised that application of paint, epoxy and protective coating materials may be hazardous. Take all necessary precautions to ensure the safety of workers and property.
- B. Be advised that as a part of this work abrasive blasting is required. This may require the use of special equipment. Become familiar with the existing site conditions and take all steps necessary to protect adjacent facilities and

- personnel, at no additional cost to the County. In addition, abrasive blasting and painting is called for in, on or around mechanical equipment, which may be damaged by grit, dust, or painting overspray. Mask, wrap, enclose and provide all protection required to safeguard this equipment at no additional cost to the County.
- C. Perform abrasive blasting activities in a manner that will not cause nuisance to adjacent public and private property and equipment.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. The Coating Detail Sheets in paragraph 2.02.B. refer to specific named manufacturers and have been provided as levels of quality as well as jurisdictional VOC compliance for the specified substrate and exposure conditions. Although not stated on the Coating Detail Sheets, the term "or approved equal" is applicable.
- B. Coatings used in each coating system shall be the products of a coating manufacturer. Mixed manufacturer coating systems are prohibited.
- C. Alternate coating systems submitted for consideration must be of the same generic type as those specified.
- D. Coatings shall not contain heavy metals that exceed the regulated levels of the jurisdiction in which the coatings will be applied.
- E. Colors are to be factory mixed, using light-fast colorants proportioned by accurate measurement into proper type base. All coatings must be formulated to perform in the climate and environment to which they will be exposed.
- F. ABRASIVE MEDIA:
1. Shall not be classified as a health or environmental hazard.
 2. Shall be delivered to the site in sealed bag or containers.
 3. Shall be kept clean and dry while stored on site.
 4. Shall not be reused for abrasive blasting unless specifically manufactured for reuse and appropriate recycling equipment is utilized.
 5. Shall be of an appropriate size, shape, and hardness to produce the specified surface profile(s).
- G. The Contractor shall provide one unopened gallon container of each color and type of coating and solvent / thinner applied during the course of the project to the County upon completion of the project.

2.02 COATING SYSTEMS

A. SYSTEM DESIGNATIONS AND RELATED REQUIREMENTS:

1. The following table provides a generic list of the coating systems by both substrate and exposure conditions. Additional information regarding; surface preparation, application, dry film thicknesses, and approved products by manufacturer is provided on the Coating Detail Sheets.
2. It shall be the Contractor's responsibility to ensure that there is chemical compatibility between all shop applied primers or coatings on all machinery and equipment provided for the project and any field applied coatings. Compatibility shall mean that there is no chemical reactivity or physical property of the shop or field applied coatings which will cause or promote intercoat adhesion problems or proper cure problems for the shop or field applied coatings on machinery or equipment or piping. The Contractor shall provide written confirmation by the shop and field applied coating manufacturers that compatibility has been checked and approved by those manufacturers. The rework to correct any compatibility problem between shop and field applied coatings shall be solely the responsibility of the Contractor at no additional cost to the County.

SYSTEM IDENTIFICATION	SUBSTRATE	EXPOSURE
System No. 1: Epoxy	Metal	Interior Exterior (Covered) No Direct Sunlight Non-Immersion Non-Corrosive
System No. 2: Zinc-Epoxy-Urethane	Metal	Atmospheric Exterior Direct Sunlight Non-Immersion Mildly Corrosive
System No. 4: Blended Amine Cured Epoxy (Spray Applied)	Metal	Immersed/Non-Immersed Severely Corrosive New Construction Biogenic Sulfide Corrosion

SYSTEM IDENTIFICATION	SUBSTRATE	EXPOSURE
System No. 4-A: Blended Amine Cured Epoxy (Trowel Applied Surfacer and Spray Applied Coating)	Concrete	Immersed/Non-Immersed Severely Corrosive New Construction Biogenic Sulfide Corrosion

B. Coating System Detail Sheets: As follows.

Coating Detail Sheet:**System No. 1**

Coating Material:

Epoxy

Surface:

Metal

Service Condition:

Interior; exterior, covered, not exposed to direct sunlight, mildly corrosive exposure.

Surface Preparation:

General:

Shop primed surfaces which are to be incorporated in the work shall be prepared in the field by cleaning surfaces in accordance with SSPC SP-2 (Hand Tool Cleaning). Damaged shop coated areas shall be cleaned in accordance with SSPC SP-5 (White Metal Blast Cleaning) to achieve a uniform surface profile of 2.0 to 2.5 mils and spot primed with the primer specified. Shop epoxy primed surfaces shall require light abrasive and vacuum cleaning blasting prior to receiving finish coats.

Ferrous Metal:

Bare ferrous metal surfaces shall be prepared in accordance with SSPC SP-6 (Commercial Blast Cleaning) to achieve a uniform, surface profile of 2.0 to 2.5 mils.

Ferrous metal with rust bleeding shall be cleaned in accordance with SSPC SP-1 (Solvent Cleaning). Areas of rust penetration shall be spot blasted to SSPC SP-10 (Near White Blast) (to achieve the 2.0 to 2.5 mil surface profile) and spot primed with the specified primer. For ductile iron surfaces, refer to the requirements in paragraph 09960-3.02.D.

Nonferrous and Galvanized Metal:

Nonferrous and galvanized metal shall be prepared in accordance with SSPC SP-16 to achieve a uniform, minimum surface profile 1.0 to 1.5 mils

Application:	Field
General:	Prime coat may be thinned and applied as recommended by the coating manufacturer, provided the coating as applied complies with prevailing air pollution control regulations.
Ferrous Metal:	Prime coats shall be an epoxy primer compatible with the specified finish coats and applied in accordance with the written instructions of the coating manufacturer.
Nonferrous and Galvanized Metal:	Nonferrous and galvanized metal shall be cleaned prior to the application of the prime coat in accordance with SSPC SP-1 (Solvent Cleaning).
System Thickness:	Minimum 10 mils dry film.
Coatings:	
Primer:	One coat at coating manufacturer's recommended dry film thickness.
Finish:	One or more coats at the coating manufacturer's recommended dry film thickness per coat to achieve the specified system thickness.
Approved Products:	

System Manufacturer	First/Prime Coat(s)	Finish Coat(s)
PPG	Amerlock 2/400	Amerlock 2/400
Carboline	Carboguard 890	Carboguard 890
International	Devran 224 HS	Devran 224 HS
Sherwin Williams	Macropoxy 646 CA	Macropoxy 646 CA
Tnemec	Series V69	Series V69

Coating Detail Sheet:**System No. 2**

Coating Material:

Zinc-Epoxy-Polyurethane System

Surface:

Metal

Service Condition:

Exterior, exposed to direct sunlight, mildly corrosive, non-immersed.

Surface Preparation:

General:

Shop primed surfaces which are to be incorporated in the work shall be prepared in the field by cleaning surfaces in accordance with SSPC SP-2 (Hand Tool Cleaning). Damaged shop coated areas shall be cleaned in accordance with SSPC SP-3 (Power Tool Cleaning) and recoated with the primer specified.

Ferrous Metal:

Bare ferrous metal surfaces shall be prepared in accordance with SSPC SP-6 (Commercial Blast Cleaning) 2.5 – 3.0. Ductile iron surfaces to be coated shall be abrasive blast cleaned in accordance with paragraph 09960-3.02 D.

Ferrous metal with rust bleeding shall be cleaned in accordance with SSPC-SP-11 (Power Tool Cleaning to Bare Metal). Areas of rust penetration shall be spot blasted to SSPC SP-10 (Near White Blast) and spot primed with the specified primer.

Galvanized Metal:

Damaged galvanized steel areas with exposed ferrous metal and/or rusted shall be cleaned in accordance with SSPC SP-5 (White Metal Blast Cleaning) or Power Tool Cleaned to Bare Metal in accordance with SSPC-SP-11 to achieve a uniform 1.0 to 1.5-mil profile and spot primed with the primer specified.

	Nonferrous and galvanized metal shall be prepared in accordance with SSPC SP-16 to impart a 1.0 to 2.0-mil profile to the galvanized steel surfaces. Where this cannot be performed, prepare by abrading in accordance with SSPC-SP-3, Power Tool Cleaning to impart a 1.0 to 1.5-mil profile uniformly to the galvanized steel surfaces.
	For System No. 2 over galvanized steel, delete the zinc rich primer.
Application:	Field
General:	Prime coat may be thinned and applied as recommended by the coating system manufacturer, provided the coating as applied complies with prevailing air pollution control regulations.
Ferrous Metal:	Prime coats shall be a zinc rich epoxy or polyurethane primer compatible for use with urethane finish coats and applied in accordance with written instructions of the coating manufacturer or in the case of CARB or SCAQMD applications, prime with specified primer that is not zinc rich. In these cases, only a two-coat system is applied.
System Thickness:	Minimum of; 3 to 4 mils of zinc rich primer, one intermediate or primer epoxy coat at 5 to 6 mils and one finish coat of polyurethane at 2 to 3 mils DFT.
Coatings:	
Primer:	One coat at the coating manufacturer's recommended dry film thickness per coat to meet the specified minimum thickness.
Intermediate:	One coat at the coating manufacturer's recommended dry film thickness per coat to meet the specified minimum thickness.

Finish: One coat at the coating manufacturer's recommended dry film thickness per coat to meet the specified minimum thickness.

Approved Products:

System Manufacturer	First/Prime Coat(s)	Intermediate Coat(s)	Finish Coat(s)
PPG	Amercoat 68HS	Amercoat 385	Amercoat 450H
Carbofine	Carbozinc 859	Carboguard 890	Carbothane 134
International Paint	Cathacoat 313	Devran 223 or Devran 224 HS	Devthane 379
Sherwin Williams	Zinc Clad IV	Macropoxy 646	Hi Solids Polyurethane
Tnemec	Series 90-97	Series V69	Series 1075

Coating Detail Sheet:

System No. 4

Coating Material: Blended Amine Cured Epoxy – Spray Applied

Surface: Metal

Service Condition: Immersed, nonpotable; non-immersed, corrosive environment, color not required especially for headspace environments that are corrosive due to biogenic sulfide corrosion.

Surface Preparation:

Ferrous Metal: Ferrous metal surfaces shall be prepared in accordance with SSPC SP-5 (White Metal Blast Cleaning) to achieve a uniform surface profile of 3.0 to 3.5 mils. Blast Cleaning shall produce a minimum surface profile of 3.0 mils.

Shop primed surfaces which are to be incorporated in the work shall be prepared in the field by cleaning surfaces in accordance with SSPC SP-11 (Power Tool Cleaning to Bare Metal). Damaged shop coated areas

shall be cleaned in accordance with SSPC SP-5 (White Metal Blast Cleaning) and spot primed with the primer specified. Shop epoxy primed surfaces shall require light abrasive blasting and blow down cleaning prior to receiving finish coats. Cast or ductile iron surfaces to be coated shall be abrasive blast cleaned to a clean, gray uniform metal appearance free of variations in color and loose materials. Ductile and cast iron surfaces shall be prepared in accordance with paragraph 09960-3.02 D.

Nonferrous and Galvanized Metal:

Nonferrous and galvanized metal shall be prepared in accordance with SSPC SP-16 to achieve a uniform surface profile of 2.0 to 2.5 mils. Galvanized metal should generally not be used in these environments.

Application:

General:

Prime coat may be thinned and applied as recommended by the coating manufacturer, provided the coating as applied complies with prevailing air pollution control regulations.

Drying time between coats shall be as specified by the coating manufacturer for the site conditions. If the maximum recoat time is exceeded, surface preparation shall require solvent washing, light abrasive blasting, or other procedures per coating manufacturer's instructions.

Ferrous Metal:

If shop priming is required or field priming is necessary, the prime coat shall be an epoxy primer compatible with the specified coating system. Generally, System No. 4 is self-priming and does not require a primer unless there is a special reason to prime the steel to hold the blast cleaning from rusting back.

System Thickness:

30 to 40 mils dry film.

Coatings:

Primer:

One coat at the coating manufacturer's recommended dry film thickness only if required by special circumstances.

Finish:

One or more coats at the coating manufacturer's recommended dry film thickness per coat to the specified system thickness.

Testing:

Holiday detection shall be performed over 100% of the coated surface area to identify any holidays or pinholes which must be repaired.

Pinhole and Holiday:

Repair Procedure: Pinholes and holidays identified by Holiday Detection shall be repaired as follows:

- Using a pencil grinder, remove a ½-inch-diameter area of the coating system material back to the ferrous metal substrate. The metal must be shiny.
- Aggressively sand or abrade the intact coating system surface 2 inches around the complete periphery of the ½-inch-diameter removal area to produce a uniform 6 to 8 mils profile.
- Vacuum clean the prepared area to remove all dust and dirt to achieve a clean, sound surface. Tape the peripheral area to prevent coating application onto unprepared surfaces.
- Brush apply one coat of the finish coating material. Following proper recoat cure time, apply additional coats of the finish coating system to achieve 40 mils DFT at the coating removal area and feather the coating onto the roughened coated surfaces to form a neat repair outline.

Approved Products:

System Manufacturer	First/Prime Coat(s)	Finish Coat(s)
Carboline	Plasite 4500S	Plasite 4500S
Sauereisen	Sewergard 210S	Sewergard 210S
Tnemec	Series 435	Series 435

Coating Detail Sheet:

System No. 4-A

Coating Material: Blended Amine Cured Epoxy – Trowel Applied Surfacer and Spray Applied Coating

Surface: Concrete

Service Condition: Immersed, non-potable; non-immersed, corrosive environment; color not required; especially for headspace environments that are corrosive due to biogenic sulfide corrosion and H₂S gas concentration up to 300 ppm.

Surface Preparation:

Concrete and Masonry Surfaces:

All coating termination and transition details shall be prepared in accordance with the coating manufacturer's standard detail drawings. This includes coating termination details, coating transitions at vertical and vertical to horizontal corners, coating terminations at joints, concrete crack treatment, pipe penetration treatment, coating terminations at metal embedments in the concrete substrate, and other details. The coating manufacturer's standard detail drawings shall be submitted for all such coating applications. If standard details are not available for a given detail treatment, the coating manufacturer shall be required to produce one at no additional cost to the owner, the engineer, or any other party.

If wet abrasive or water blasting surface preparation methods were used, the concrete substrate shall be allowed to dry under warm conditions (minimum of 75°F) for at least 5 days prior to coating application. Following surface preparation work and dry-out, all surfaces to be

coated shall be vacuum cleaned to remove all loose dirt, dust, or other loose materials.

Concrete:

Concrete surfaces shall be allowed to cure for at least 28 days and allowed to dry to the moisture content recommended by the coating manufacturer. Moisture content may be tested by the Construction Manager with a Delmhorst Instrument Company moisture detector, or equal. Except as otherwise specified, loose concrete, form oils, surface hardeners, curing compounds, and laitance shall be removed from surfaces by abrasive blasting and chipping, and voids and cracks shall be repaired as specified in Division 3. Surface Preparation must open up all shelled over air voids or bug holes to fully expose the void's depth, width, and length. Concrete shall be abraded to achieve a uniform concrete surface profile of CSP-5 in accordance with ICRI 310.2. After surface preparation has been accepted, a complete skim coat of the specified filler surface shall be applied over all concrete surfaces and all "bug holes" (air voids) shall be completely filled using this same material. The filler surface material shall be applied as a complete parge coat of the substrate. If the parge coat (filler/surface material) is non-polymer modified, it must be brush blast cleaned following adequate cure per coating manufacturer's instructions to produce a uniform anchor pattern of CSP-4 in accordance with ICRI 310.2 prior to coating application.

Application:

Field for Concrete Substrates

Surfacer or filler shall be applied per coating manufacturer's recommendations prior to application of coating to fill all bug holes and voids and create a complete parge coat of the prepared substrate. This parge coat shall completely fill all bug holes and voids in the substrate and will also completely cover the substrate unless specified otherwise above such filled voids by 1/8-inch (125 mils) of thickness.

Drying time between coats shall be as specified by the coating manufacturer for the site

conditions. If the maximum recoat time is exceeded, surface preparation shall require solvent washing, light abrasive blasting, or other procedures per coating manufacturer's instructions.

System Thickness: 80 – 120 mils dry film in addition to the 1/8-inch parge coat.

Coatings:

Finish: Two coats to the specified system thickness as per the below coating manufacturer's recommended dry film thickness per coat.

Testing: Holiday detection shall be performed over 100% of the coated surface area to identify any holidays or pinholes which could compromise coating system performance. Holiday testing to be performed after application and adequate cure of the spray applied epoxy coating material. Holiday detection shall be performed in accordance with NACE RP0188.

Pinhole and Holiday Repair Procedure:

Pinholes and holidays identified by Holiday Detection shall be repaired as follows:

- Using a pencil grinder or other suitable power tool, remove the coating system at all pinholes or holidays in an area at least 2 inches in diameter or in both dimensions around the defect back to the concrete substrate.
- Chip out and remove the concrete to expose the full dimensions in all three directions of the air void responsible for the defect.
- Aggressively abrade or sand the intact coating system surface at least 3 inches beyond the removal area in all directions to produce a uniform 6 to 8 mil profile in the intact coating system.
- Vacuum clean the prepared area to remove all dust, dirt, etc. leaving clean sound surfaces.

- Tape to mask the periphery of the prepared intact coating area to prevent coating repair application onto the prepared area.
- Using a putty knife or other suitable tool, fill the opened void with the approved filler surface material completely and strike-off. Allow to cure per coating manufacturer's recommendations.
- Apply the coating system in the number of coats necessary to achieve the specified 80 – 120 mils DFT over the defect and coating removal area and feather the coating onto the abraded coated surfaces around the removal area to avoid a lip and to achieve a neat repair outline. Allow to cure properly.

Approved Products:

System Manufacturer	Surfacer	First Coat	Gel/Finish Coat
Sauereisen	209HB	Sewergard 210S	Sewergard 210G
Themec	Series 218	Series 436	Series 436

PART 3 - EXECUTION

3.01 COATINGS

A. GENERAL:

1. Coating application shall not proceed until the Construction Manager has inspected the materials, and the coating manufacturer has trained the contractor in the surface preparation, mixing and application of each coating system.

B. SHOP AND FIELD COATS:

1. Shop Applied Prime Coat: Except as otherwise specified, prime coats may be shop-applied or field-applied. Shop-applied primer shall be compatible with the specified coating system and shall be applied at the minimum dry film thickness recommended by the coating manufacturer. Product data sheets identifying the shop primer used shall be provided to the on-site coating application personnel. Adhesion tests shall be performed on the shop primer as specified in paragraph 3.01-B-3. Damaged, deteriorated and poorly applied shop coatings that do not

- meet the requirements of Section 09960 shall be removed and the surfaces recoated. If the shop prime coat meets the requirements of Section 09960, the field coating may consist of touching up the shop prime coat and then applying the finish coats to achieve the specified film thickness and continuity.
2. Field Coats: Field coats shall consist of one or more prime coats and one or more finish coats to build up the coating to the specified dry film thickness. Unless otherwise specified, finish coats shall not be applied until other work in the area is complete and until previous coats have been inspected.
 3. Adhesion Confirmation: The Contractor shall perform an adhesion test after proper cure in accordance with ASTM D3359 to demonstrate that (1) the shop applied prime coat adheres to the substrate, and (2) the specified field coatings adhere to the shop coat. Test results showing an adhesion rating of 5A on immersed surfaces and 4A or better on other surfaces shall be considered acceptable for coatings 5 mils or more in thickness (Method A). Test results showing an adhesion rating of 5B on immersed surfaces and 4B or better on other surfaces shall be considered acceptable for coating thicknesses less than 5 mils.

C. APPLICATION LOCATION REQUIREMENTS:

1. Equipment, Nonimmersed: Items of equipment, or parts of equipment which are not immersed in service, shall be shop primed and then finish coated in the field after installation with the specified or acceptable color. If the shop primer requires top coating within a specified period of time, the equipment shall be finish coated in the shop and then touch-up painted after installation. If equipment removal and reinstallation is required for the project, touch-up coating work shall be performed in the field following installation.
2. Equipment, Immersed: Items of equipment, or parts and surfaces of equipment which are immersed when in service, with the exception of pumps and valves, shall have surface preparation and coating work performed in the field. Coating systems applied to immersed equipment shall be pinhole free.

3.02 PREPARATION

A. GENERAL:

1. Surface preparations for each type of surface shall be in accordance with the specific requirements of each Coating System Detail Sheet (CDS) and the manufacturer's requirements. In the event of a conflict the more stringent requirement shall take precedence.
2. Surfaces to be coated shall be clean and dry. Before applying coating or surface treatments, oil, grease, dirt, rust, loose mill scale, old-weathered coatings, and other foreign substances shall be removed. Oil and grease

shall be removed before mechanical cleaning is started. Where mechanical cleaning is accomplished by blast cleaning, the abrasive used shall be washed, graded and free of contaminants which might interfere with the adhesion of the coatings. The air used for blast cleaning shall be sufficiently free of oil and moisture to not cause detrimental contamination of the surfaces to be coated.

3. Cleaning and coating shall be scheduled so that dust and spray from the cleaning process shall not fall on wet, newly coated surfaces. Hardware, hardware accessories, nameplates, data tags, machined surfaces, sprinkler heads, electrical fixtures, and similar uncoated items which are in contact with coated surfaces shall be removed or masked prior to surface preparation and painting operations. Following completion of coating, removed items shall be reinstalled. Equipment adjacent to walls shall be disconnected and moved to permit cleaning and painting of equipment and walls and, following painting, shall be replaced and reconnected.
4. Containment: The contractor shall erect and maintain protective enclosures as required to ensure that surface preparation debris, including dust, is contained within the immediate work area. All costs associated with containment shall be paid by the contractor.
5. Dust and Contaminants: Protect substrate from excessive dust and airborne contaminants during coating application and curing. Use temporary dust barriers to close off areas being painted from areas where other work is being performed.

B. **ABRASIVE BLAST CLEANING:**

1. When abrasive blast cleaning is required to achieve the specified surface preparation the following requirements for blast cleaning materials and equipment shall be met:
2. Used or spent blast abrasive shall not be reused on this project.
3. The compressed air used for blast cleaning shall be filtered and shall contain no condensed water and no oil. Moisture traps shall be cleaned at least once every four hours or more frequently as required to prevent moisture from entering the supply air to the abrasive blasting equipment.
4. Oil separators shall be installed just downstream of compressor discharge valves and at the discharge of the blast pot discharges. These shall be checked on the same frequency as the moisture traps as defined in item 2 above.
5. Regulators, gauges, filters, and separators shall be in use on compressor air lines to blasting nozzles times during this work.
6. An air dryer or desiccant filter drying unit shall be installed which dries the compressed air prior to blast pot connections.
7. The air dryer shall be used and maintained for the duration of surface preparation work.
8. The contractor shall provide ventilation for airborne particulate evacuation (meeting pertinent safety standards) to optimize visibility for

- both blast cleaning and inspection of the substrate during surface preparation work.
9. If, between final surface preparation work and coating system application, contamination of prepared and cleaned metallic substrates occurs, or if the prepared substrates' appearance darkens or changes color, re-cleaning by water blasting, re-blasting and abrasive blast cleaning shall be required until the specified degree of cleanliness is reclaimed.
 10. The contractor is responsible for dust control and for protection of mechanical, electrical, and other equipment adjacent to and surrounding the work area.

C. SOLVENT CLEANING:

1. Any solvent wash, solvent wipe, or cleaner used, including but not limited to those used for surface preparation in accordance with SSPC SP-1 Solvent Cleaning shall be of the emulsifying type which emits no more than 340 g/l VOCs, contains no phosphates, is biodegradable, removes no zinc, and is compatible with the specified primer.
2. Clean white cloths and clean fluids shall be used in solvent cleaning.

D. FERROUS METAL SUBSTRATES

1. Ferrous surfaces shall be prepared in accordance with applicable surface preparation specifications of SSPC / NACE specified for each coating system. Specific surface preparation requirements are stated on the CDS. The profile depth of the surface to be coated shall be in accordance with the CDS requirements and shall be measured by Method C of ASTM D4417. Blast particle size shall be selected by the Contractor to produce the specified surface profile. The solvent in solvent cleaning operations shall be as recommended by the coating manufacturer.
2. Preparation of ferrous metal surfaces shall be based upon comparison with SSPC-VIS1, and as described in the CDS for each coating system. If dry abrasive blast cleaning is selected and to facilitate inspection, the Contractor shall, on the first day of cleaning operations, abrasive blast metal panels to the standards specified. Plates shall measure a minimum of 8-1/2 inches by 11 inches. Panels meeting the requirements of the specifications shall be initialed by the contractor and the Construction Manager and coated with a clear non-yellowing finish. One of these panels shall be prepared for each type of abrasive blasting and shall be used as the comparison standard throughout the project.
3. Blast cleaning requirements for steel, ductile iron, and stainless steel substrates are as follows:
 - a. Ferrous steel piping shall be prepared in accordance with SSPC SP-6 and primed before installation.

- b. Ductile iron piping surfaces including fittings shall be prepared in accordance with NAPF 500-03, NAPF 500-03-04, and NAPF 500-03-05.
- c. Stainless steel surfaces shall be prepared in accordance with SSPC SP-16.
- d. Remove traces of grit, dust, dirt, rust scale, friable material, loose corrosion products or embedded abrasive from substrate by vacuum cleaning prior to coating application.
- e. Care must be taken to prevent contamination of the surface after blasting from worker's fingerprints, deleterious substances on workers' clothing, or from atmospheric conditions.

E. CONCRETE SURFACES:

1. Inspection of concrete surfaces prior to surface preparation and surface preparation of concrete surfaces shall be performed in accordance with SSPC-SP13/NACE
2. Prepare substrate cracks, areas requiring resurfacing and perform detail treatment including but not limited to, terminating edges, per coating manufacturer's recommendations. This shall precede surface preparation for degree of cleanliness and profile.
3. The surface profile for prepared concrete surfaces to be coated shall be evaluated by comparing the profile of the prepared concrete with the profile of graded abrasive paper, as described in ANSI B74.18 or by comparing the profile with the ICRI 310.2 (surface profile replicas). Surface profile requirements shall be in accordance with the CDS requirements and the coating manufacturer's recommendations.
4. Surface cleanliness of prepared concrete substrates shall be inspected after cleaning, preparation, and/or drying, but prior to making repairs or applying a coat in the coating system. If concrete surfaces are repaired, they shall be re-inspected for surface cleanliness prior to application of the coating system.
5. Surface preparation of concrete substrates shall be accomplished using methods stated in SSPC SP-13/NACE 6. The selected cleaning method shall produce the requirements set forth below.
 - a. A clean substrate that is free of calcium sulfate, loose coarse or fine aggregate, laitance, loose hydrated cement paste, and otherwise deleterious substances shall be achieved. Blast cleaning and other means necessary shall be used to open up air voids or "bug holes" to expose their complete perimeter. Leaving shelled over, hidden air voids beneath the exposed concrete surface is not acceptable. Concrete substrate must be dry prior to the application of filler/surface or coating system materials.
 - b. Acceptable surface preparation must produce a concrete surface with a minimum pH of 8.0 to be confirmed by surface pH testing. If after surface preparation, the surface pH remains below 8.0, perform additional water blasting, cleaning, or abrasive blast

- c. cleaning until additional pH testing indicates an acceptable pH level.
- c. Following inspection by the contractor of the concrete surface preparation, thoroughly vacuum clean concrete surfaces to be coated to remove loose dirt and spent abrasive (if dry blast cleaning is used) leaving a dust free, sound concrete substrate. Debris produced by blast cleaning shall be removed from the structures to be coated and disposed of legally off site by the Contractor.
- 6. Should abrasive blast cleaning or high or ultrahigh pressure water blasting not remove degraded concrete, chipping or other abrading tools shall be used to remove the deteriorated concrete until a sound, clean substrate is achieved which is free of calcium sulfate, loose coarse or fine aggregate, laitance, loose hydrated cement paste, and otherwise deleterious substances. Concrete substrates must be dry prior to the application of filler-surfacers or coating system materials.
- 7. Surface cleanliness of prepared concrete substrates shall be inspected after cleaning, preparation, and/or drying, but prior to application of coating materials. If concrete surfaces are repaired, they shall be re-inspected for surface cleanliness and required surface profile prior to application of the coating system.
- 8. Moisture content of concrete to be coated shall be tested in accordance with ASTM D4263, Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method or ASTM F 1869, Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride. The ASTM D4263 plastic sheet test shall be conducted at least once for every 500-square foot of surface area to be coated. The presence of any moisture on plastic sheet following test period constitutes a non-acceptable test. For concrete surfaces to be coated which are on the negative or back side of concrete walls or structures exposed to soils (back filled) or immersed, should be waterproofed. Perform calcium chloride tests in accordance with ASTM F1869 once for each 500-square foot of surface area to be coated. The contractor shall ensure that the moisture content of the concrete is within the written parameters established by the coating system manufacturer.

F. MASONRY SURFACES:

1. Prepare masonry surfaces such as Concrete Masonry Units (CMU) to remove chalk, loose dirt, dried mortar splatter, dust, peeling or loose existing coatings, or otherwise deleterious substances to leave a clean, sound substrate.
2. Be certain masonry surfaces are dry prior to coating application. If pressure washing or low-pressure water blast cleaning is used for preparation, allow the masonry to dry for at least 5 days under dry weather conditions or when the minimum ambient temperature is 70°F prior to coating application work.

G. THERMOPLASTIC SURFACES:

1. Prepare surfaces of polyethylene, PVC, or CPVC by sanding to establish uniform surface roughness and to remove gloss from substrate. Next, vacuum clean to remove loose dust, dirt, and other materials. Next, solvent clean using clean white rags and allow solvent to completely evaporate before application of coating materials.

H. FIBERGLASS REINFORCED PLASTIC SURFACES:

1. Fiberglass surfaces shall be cleaned with a solvent compatible with the specified primer and sanded to roughen surfaces to achieve a uniform surface profile of 1.0 to 1.5 mils. Vacuum clean after sanding to remove all loose dust, particles, dirt, or other contaminants.

I. GALVANIZED STEEL SURFACES:

1. Prepare in accordance with SSPC-SP16 to impart a uniform surface profile to the galvanized steel surfaces. Where this cannot be performed, prepare by abrading in accordance with SSPC-SP3, Power Tool Cleaning to achieve a uniform surface profile. Vacuum clean and solvent clean after blast cleaning or abrading and allow the solvent to fully evaporate prior to any coating application.

3.03 APPLICATION

A. WORKMANSHIP:

1. Coated surfaces shall be free from excessive runs, sags, drips, ridges, waves, laps, and brush marks. Coats shall be applied to produce an even film of uniform thickness completely coating corners and crevices. Minor and infrequent runs and sags which are within the total specified D.F.T. plus a few mils (no more than 10% more mils than the specified total D.F.T.) will be acceptable. However, frequent runs or sags which exceed these limits or otherwise will be detrimental to coating system performance will not be acceptable.
2. The contractor's spray equipment shall be designed for application of the materials specified. Compressors shall have suitable traps and filters to remove water and oils from the air. Spray equipment shall be equipped with mechanical agitators, pressure gages, and pressure regulators, and properly sized spray tips.
3. Each coating application be applied evenly and sharply cut to line. Care shall be exercised to avoid overspray or spattering paint on surfaces not to be coated. Glass, hardware, floors, roofs, and other adjacent areas and installations shall be protected by taping, drop cloths, or other suitable measures.

4. Coating applications method shall be as recommended by the coating manufacturer.
5. Allow each coat to cure or dry thoroughly, according to the coating manufacturer's printed instructions, prior to recoating.
6. Vary color for each successive coat for coating systems when possible.
7. When coating complex steel shapes, prior to overall coating system application, stripe coat welds, edges of structural steel shapes, metal cut-outs, pits in steel surfaces, or rough surfaces with the prime coat. This involves applying a separate coat using brushes or rollers to ensure proper coverage. Stripe coat via spray application is not permitted.

B. COATING PROPERTIES - MIXING AND THINNING:

1. Coatings, when applied, shall provide a satisfactory film and smooth even surface. Glossy undercoats shall be lightly sanded to provide a surface suitable for the proper application and adhesion of subsequent coats. Coating materials shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Coatings consisting of two or more components shall be mixed in accordance with the coating manufacturer's instructions. Where necessary to suit the conditions of the surface, temperature, weather and method of application, the coating may be thinned as recommended by the coating manufacturer immediately prior to use. The volatile organic content (VOC) of the coating as applied shall comply with prevailing air pollution control regulations. Unless otherwise specified, coatings shall not be reduced more than necessary to obtain the proper application characteristics. Thinner shall be as recommended by the coating manufacturer.
2. Mixing of partial "kits" is strictly prohibited unless authorized in writing by the coating manufacturer and the Construction Manager. This prohibition also applies to coatings mixed for touchup or repairs. If authorized to mix partial kits, the contractor shall utilize containers with appropriate graduated markings / calibrated weight scales.

C. ENVIRONMENTAL CONDITIONS:

1. Provide adequate heat, ventilation, and dehumidification to ensure that the coating manufacturer's environmental requirements are met and to ensure no loss of production days due to failure to meet coating manufacturer's environmental requirements.
2. Provide sufficient and continuous ventilation and air movement across coated substrates to remove volatile constituents (solvent) throughout the manufacturer's published curing period.
3. Air and surface temperatures: Prepare surfaces, apply and cure coatings within air and surface temperature range recommended by coating manufacturer.

4. Relative humidity: Prepare surfaces, apply and cure coatings within relative humidity range in accordance with coating manufacturer's instructions.
5. Dew Point: Do not apply coatings unless the temperature of the dew point is 5°F or greater than the temperature of the substrate.
6. Precipitation: Do not apply coatings in rain, snow, fog, or mist.
7. Wind: Do not spray apply coatings when the wind direction and velocity are such that overspray may result in property damage.

D. CONCRETE SUBSTRATE TEMPERATURES AND DETAIL TREATMENT:

1. When the surface temperatures of the concrete substrates to be coated are rising or when these substrates are in direct sunlight, outgassing of air from the concrete may result in bubbling, pinhole formations, or blistering in the coating system. The application of the filler-surface and the coating system will only be allowed during periods of falling temperature. This may require that application of the filler-surfacer and coating system to occur during the cooler evening hours. Contractor shall include any cost for working outside of normal hours in the bid.
2. Should bubbles, pinholes, or discontinuities form in the applied coating system material, they shall be repaired as recommended by the coating manufacturer. Should pinholes develop in the filler - surfacer material or in the first coat of the coating material, the pinholes shall be repaired in accordance with the recommendations prior to application of the next coat of material. Whenever pinholes occur, the air void behind or beneath the pinhole shall be opened up completely and then completely filled with the specified filler -surfacer material. Next, the coated area around the pinhole repair shall be abraded and the coating reapplied over that area.
3. Perform application detail work per the coating manufacturer's current written recommendations and/or drawings.

E. PROTECTION OF COATED SURFACES:

1. Items which have been coated shall not be handled, worked on, or otherwise disturbed, until the coating is completely dry and hard. After delivery at the site, and upon permanent erection or installation, shop-coated metalwork shall be recoated or retouched with specified coating when it is necessary to maintain the integrity of the film.

F. FILM THICKNESS AND CONTINUITY:

1. WFT of the first coat of the coating system and subsequent coats shall be verified by the contractor, during application of each coat.
2. Coatings shall be applied to the minimum dry film thickness specified as indicated on the CDS. Dry film thickness shall be determined using the appropriate industry standard for the substrate (SSPC-PA 2,

SSPC-PA 9, or ASTM D1400). Coatings determined to be above the maximum dry film thickness as indicated on the CDS or the coating manufacturer's product data sheet, will be removed at the Construction Manager's discretion.

3. In testing for continuity of coating about welds, projections (such as bolts and nuts), and crevices, the Construction Manager shall determine the minimum conductivity for smooth areas of like coating where the dry mil thickness has been accepted. This conductivity shall be the minimum required for these rough or irregular areas. Pinholes and holidays shall be recoated to the required coverage.
4. The ability to obtain specified film thickness is generally compromised when brush or roller application methods are used and, therefore, more coats may be needed to be applied to achieve the specified dry film thickness.
5. For concrete substrates, the Contractor shall apply a complete skim coat of the specified filler-surfacer material over the entire substrate prior to application of the coating system. This material shall be applied such that all open air voids and "bug holes" in the concrete substrate are completely filled prior to coating application.

G. SPECIAL REQUIREMENTS:

1. Before erection, the Contractor shall apply all but the final finish coat to, pipe hangers, piping in contact with hangers, and contact surfaces which are inaccessible after assembly. The final coat shall be applied after erection. Structural friction connections and high tensile bolts and nuts shall be coated after erection. Areas damaged during erection shall be hand-cleaned or power-tool cleaned and recoated with primer coat prior to the application of subsequent coats. Touch-up of surfaces shall be performed after installation. Surfaces to be coated shall be clean and dry at the time of application. Except for those to be filled with grout, the underside of equipment bases and supports that have not been galvanized shall be coated with at least two coats of primer specified for System 1 prior to setting the equipment in place. Provide coating system terminations at leading edges and transitions to other substrates in accordance with the coating manufacturer's recommendations or detail drawings.

H. ELECTRICAL AND INSTRUMENTATION EQUIPMENT AND MATERIALS:

1. Electrical and instrumentation equipment and materials shall be coated by the equipment manufacturer as specified below:
 - a. Finish: Electrical equipment shall be treated with zinc phosphate, bonderized or otherwise given a rust-preventive treatment. Equipment shall be primed, coated with enamel, and baked. Minimum dry film thickness shall be 3 mils.

- b. Unless otherwise specified, instrumentation panels shall be coated with System 1 for indoor mounting and System 2 for outdoor mounting.
- c. Before final acceptance, the Contractor shall touch up scratches on equipment with identical color coating. Finish shall be smooth, free of runs, and match existing finish. Prior to touching up scratches, Contractor shall fill them with an appropriate filler material approved by the coating manufacturer.
- d. Color: Exterior color of electrical equipment shall be FS 26463 (ANSI/NSF 61) light gray. Interior shall be painted FS 27880 white. Nonmetallic electrical enclosures and equipment shall be the equipment manufacturer's standard grey color.
- e. Exterior color of instrumentation panels and cabinets mounted indoors shall be FS 26463 light gray; unless otherwise specified, exterior color for cabinets mounted outdoors shall be FS 27722, white. Cabinet interiors shall be FS 27880, white.

I. SOLUBLE SALT CONTAMINATION OF METAL SUBSTRATES:

1. Contractor shall test in accordance with SSPC Guide 15 metal substrates to be coated. If testing indicates chloride levels in excess of 25 ppm exist after the surface preparation has been completed, the Contractor shall re-clean and prepare these surfaces until chloride levels are below 25 ppm.

3.04 FINISH SCHEDULE

- A. The following Finish Schedule lists all major structures, equipment, and substrates to be coated within Section 09960. There will be some minor, miscellaneous surfaces for the project that require coating application which are not listed in the Finish Schedule. The Contractor is responsible for coating those miscellaneous surfaces in accordance with the requirements of Section 09960. It is the Contractor's responsibility to identify any miscellaneous surfaces for which there is a question about what standard coating system to apply. This should be addressed in writing to the Construction Manager as required under Submittals in 1.04.A.11 of Section 09960. The Finish Schedule designates the coating system to be applied. Specific information relative to number of coats and film thicknesses is indicated on the Coating Detail Sheets found in paragraph 2.02-B.

Structure	Substrate	Coating System
Wet Well Interior	Concrete	System 4-A
Ductile Iron Pipe and Fittings Inside Wet Well	Steel	System 4
Indoor Instrumentation Panels	Steel	System 1
Outdoor Instrumentation Panels	Stainless Steel	System 2

- B. Colors shall be selected by the County, or as otherwise specified.
- C. Refer to contract drawings for details regarding coating elevation termination/transition details.
- D. Refer to the Material Schedule in Section 09900 for coating details of structures, equipment, and substrates.

3.05 INSPECTION AND TESTING BY AN INDEPENDENT THIRD PARTY

- A. The County reserves the right to engage the services of an independent third party to provide quality control inspection. Third party inspection is in addition to any inspection required to be performed by the contractor and does not limit the contractor's responsibility for quality workmanship or quality control as specified.
- B. Third party inspection will be performed in a manner which limits interference/inhibits the contractor's operations. Whenever feasible, the third party inspections will be performed concurrently with the contractor's required inspections.
- C. Testing Discrepancies: In the event that discrepancies occur relative to test methods or test results, the findings of the Independent Third Party shall be final. The contractor shall not be entitled to additional monies for rework / additional work necessary to satisfy the requirements of the specification as a result of the Independent Third Parties findings.

3.06 FINAL INSPECTION

- A. Contractor shall conduct a final inspection to determine whether coating system work meets the requirements of the specifications.
- B. The Construction Manager will subsequently conduct a final inspection with the Contractor to determine the work is in conformance with requirements of the contract documents.
- C. Any rework required shall be marked. Such areas shall be re-cleaned and repaired as specified at no additional cost to the County.

3.07 CLEANUP

- A. Upon completion of the work, the Contractor shall remove and dispose of; surplus materials, protective coverings, spent abrasive, and accumulated rubbish.
- B. All surfaces shall be thoroughly cleaned and any damage resulting from surface preparation or coating application shall be repaired.

END OF SECTION

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SECTION 10050

BUILDING SPECIALTIES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Fire extinguishers and fire extinguisher brackets.
 - 2. Rubber switchboard mats.

1.02 SUBMITTALS

- A. Product Data: Fully describe all products proposed for use.
- B. Manufacturer's Instructions: For installation of all items.

PART 2 - PRODUCTS

2.01 FIRE EXTINGUISHER CABINETS AND FIRE EXTINGUISHERS

- A. At Generator Room 202, provide one (1) surface mount steel extinguisher bracket and provide for each extinguisher bracket, (1) – 20 lb. multi-purpose 4A60BC Fire Extinguisher. Shell of extinguisher shall be painted OSHA Red. All extinguishers shall be by one manufacturer and shall have a State and/or local Fire Marshal's inspection and fill tag dated within 90 days of project acceptance and issued by the State and/or local Fire Marshal of the State in which the extinguisher is installed. Larsen Architectural Series; J. L. Industries; or equal. Locations as shown on Drawings. Mount centerline of bracket at 40 inches above finished floor.
- B. At Electrical Room 201, provide one (1) surface mount steel extinguisher bracket and provide for each extinguisher bracket, (1) - 11 lb. Halotron I FM11C. Shell of extinguisher shall be painted OSHA Red. All extinguishers shall be by one manufacturer and shall have a State and/or local Fire Marshal's inspection and fill tag dated within 90 days of project acceptance and issued by the State and/or local Fire Marshal of the State in which the extinguisher is installed. Larsen Architectural Series; J. L. Industries; or equal. Location as shown on Drawings. Mount centerline of bracket at 40 inches above finished floor.

2.02 RUBBER SWITCHBOARD MATS

- A. Provide corrugated fiber reinforced rubber mats, which conform to ASTM D178-01, Type I, oil resistant. Mats shall meet OSHA requirements. Mats for low voltage (below 1 kV) switchboards and switchgear and motor control centers shall be rated for protection for 17,000 volts minimum to ground. Mats for medium voltage (1 kV to 15 kV) switchgear shall be rated 17,000 volts. Test voltage: 30,000 volts.
- B. Mat shall be a minimum of 1/4-inch-thick and black in color with beveled edges. Mats shall extend the full width of the equipment (minimum 30 inches). Mats shall be 4 feet deep in front of low voltage equipment and 6 feet deep in front of medium voltage equipment. Provide mats for all switchboards and motor control centers whether shown or not.
- C. Installation: Install at locations shown on the Drawings and in front of all switchboards and motor control centers.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Fire Extinguishers: Comply with NFPA Standard No. 10. Install cabinets and mount extinguishers where directed or where shown.
- B. Install rubber switchboard mats as described in Part 2. and where directed.

END OF SECTION

SECTION 10200

LOUVERS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Wall louvers.

1.02 REFERENCES

- A. Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
 - 1. Architectural Sheet Metal Manual
- B. Air Control Division of the Air Movement and Control Association (AMCA)
 - 1. AMCA-500-L-12 Laboratory Methods of Testing Louvers for Rating
 - 2. AMCA-511 Certified Ratings Program – Product Rating Manual for Air Control Devices
 - 3. AMCA-540 Test Method for Louvers Impacted by Wind Borne Debris
- C. ASTM International (ASTM):
 - 1. D1187 Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal
- D. National Association of Architectural Metal Manufacturers (NAAMM)
 - 1. AMP 500 Metal Finishes Manual

1.03 SUBMITTALS

- A. Submit the following:
 - 1. Product Data: Fully describe all items proposed for use.
 - 2. Shop Drawings: Custom prepared for this project.
 - 3. Certified Test Data: Air and acoustic performance of louvers.

1.04 QUALITY ASSURANCE

- A. Comply with details and standards in the "Architectural Sheet Metal Manual" published by Sheet Metal and Air Conditioning Contractors National Association (SMACNA).

- B. Comply with AMCA Standard 500-L-12 for measuring air performance, water penetration and air leakage and Standard 511 for the AMCA Certified Ratings Program.

PART 2 - PRODUCTS

2.01 STATIONARY EXTRUDED ALUMINUM FRAMED CONTINUOUS BLADE LOUVERS

- A. Manufacturer: Louver style K6774 exposed vertical mullion type manufactured by Airolite; Construction Specialties; or equal.
- B. Design Criteria: Design and test louvers to AMCA Standard 500 for air performance and water penetration. Test a 4 by 4-foot louver with a minimum free area of 7.89 square feet to pass at least 800 FPM through the free area at a pressure drop not exceeding 0.15 in W.G. Limit water penetration to 10 ounces of water per square foot of free area when tested at 720 FPM for 15 minutes per AMCA Standard 500.

2.02 MATERIALS / FABRICATION

- A. Provide extruded aluminum framed continuous blade louvers with exposed jambs and mullions 6 inches deep with blades spaced 3 inches on center. Use aluminum alloy 6063-T52 for all parts.
- B. Use extruded horizontal drainable blades, 12-gauge (0.81 inches) thick, having a downward turned stiffening leg along the front bottom edge and an up turned leg with a forward-facing lip to stop water migration along the top rear edge. Use blades that have an extruded hood on their bottom surface to interlock with mullion support brackets. Set louver blades at a 30-degree angle for exhaust and 45-degree angle for intake.
- C. Contain louver blades in a frame made of 3/4-inch by 6-inch extruded aluminum "C" sections.
- D. Provide louvers that have all joints concealed.
- E. Continuously weld all joints in the louver assembly using a shielded arc process.
- F. Provide all related break shape and extruded aluminum sills, flashings, and sub-frames. Flashings shall be 0.050 or thicker as indicated.

- G. Provide matching 1/8-inch-thick dark bronze anodized aluminum backing plates to cover the rear of decorative louvers and portions of louvers outside of air intake or exhaust ductwork.
- H. Provide all required aluminum angles, tees, plates, and other shapes required for a complete installation.

2.03 FINISH

- A. Finish all parts with an anodized finish at least 0.7 mils thick conforming to NAAMM AA-M10C22A44. Color as selected from manufacturer's standard anodized colors.

2.04 LOUVER SCREENS

- A. General: Provide exterior louvers with louver screens.
 - 1. Screen Location for Adjustable Louvers: Interior face, unless otherwise indicated.
 - 2. Screening Type: Insect screening, unless otherwise indicated.
 - 3. Where ductwork is attached to the interior side of louver provide holder for screen frame that can be built into ductwork and so arranged that by opening a door in duct, screen can be slid out for cleaning without disassembling ductwork. Where there is no ductwork attached to interior of louver, provide a holder for screen frame designed so that screen can be removed for cleaning and replaced without using tools.
- B. Attachment: Secure screens to louver frames with stainless-steel machine screws, spaced 18 inches on center.
 - 1. Louver Screen Frames: As manufactured by The Airolite Co; to sizes indicated on Drawings.
 - 2. Fabrication: Mitered corners.
 - 3. Metal: Roll formed aluminum.
 - 4. Finish: Anodized to match louver frame, unless otherwise indicated.
 - 5. Type: Rewirable frames with a driven spline or insert for securing screen mesh.
- C. Louver Screening for Aluminum Louvers: As manufactured by The Airolite Co.
 - 1. Insect Screening: Aluminum, 18-by-16 mesh, 0.012-inch wire.

2.05 BITUMINOUS PAINT

- A. Bituminous Paint: Cold-applied asphalt mastic containing no asbestos fibers, or cold-applied asphalt emulsion complying with ASTM D 1187.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Protect all aluminum in contact with steel or galvanized metal with a coating of bituminous paint.
- B. Install louvers as shown in the Contract Drawings and as shown in Plates 137B and 139A of the 4th edition of the SMACNA Architectural Sheet Metal manual.
- C. Provide insect screens on all louvers. Install on the interior side. Use stainless steel screws throughout.
- D. Install sill flashing as shown detailed and as required to provide a watertight installation.
- E. Install sheet metal drip at head of louvers where shown.
- F. Apply sealant "B" all around frame, at joint with interior and exterior wall surfaces.

END OF SECTION

SECTION 10400
IDENTIFYING DEVICES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes: Room Signs, Decals and Tags.

1.02 REFERENCES

- A. American National Standards Institute / American Society of Mechanical Engineers (ANSI/ASME), ASME A13.1 - 2015, "Scheme for the Identification of Piping Systems."
- B. American National Standards Institute (ANSI), ICC A117.1 - 2009, "Accessible and Usable Buildings and Facilities".
- C. Hawaii State Building Code Council
 - 1. 2018 Hawaii State Building Code.
- D. National Fire Protection Association (NFPA) NFPA 704, "Standard System for the Identification of the Hazards of Materials for Emergency Response".

1.03 SUBMITTALS

- A. Product Data: Fully describe all items proposed for use.
- B. Shop Drawings: Scaled drawings or images of custom-made signs, showing style and size of lettering and colors.
- C. Samples: Provide one full size representative sample of each signage type, made of the specified material, from Part 2 of this Specification. Provide manufacturer's standard color palette for each selection.

1.04 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with the following:
 - 1. Americans with Disabilities Act (ADA).
 - 2. 2018 Hawaii State Building Code
 - 3. Federal and Hawaii State Occupational Safety and Health Act (OSHA): Referenced sections, specifications for accident prevention signs and tags and exit signs.
- B. Comply with the manufacturer's published recommendation for installation of materials used.

PART 2 - PRODUCTS

2.01 SIGNS

A. Architectural Signs:

1. Office/Facility Signs:
 - a. Vomar Products, Inc.; ES 100 Series; Apco Graphics IM System; or equal.
 - b. Sign characteristics:
 - 1) Material: Integral color acrylic.
 - 2) Frame and plaque in contrasting colors separated by a 1/16-inch reveal. Colors as selected from manufacturer's standard palette. Rectangular shape unless noted otherwise. Self-adhesive backing.
 - 3) Text Helvetica Bold all caps: Size shown.
 - 4) Sign size shall be as shown unless a larger size is required to accommodate lettering.
 - 5) Braille: All signs to include contracted (Grade 2) braille and comply with ICC A117.1-2009 Chapter 7 Communication Elements and Features.
 - c. Schedule of signs required:

Quantity	Text	Text Height	Size (Inches)	Comments
1	Generator Room	3/4	9Wx5-1/2 H	Provide one sign at one exterior door face
1	Electrical Room	3/4	9Wx5-1/2 H	Provide one sign at exterior door face

2.02 SAFETY SIGNAGE

A. Hazard Alerting Signage (CAUTION, WARNING, DANGER):

- a. Refer to the Signage Schedule at the end of this section to identify the sign types and quantities for the project.
 - b. Manufacturer: Seton Nameplate Company; W.H. Brady Company; or equal.
2. Signage Design:
 - a. Size: 14 inches wide by 10 inches high
 - b. Material: 60-mil rigid plastic, coated for weather and vandalism protection
 - c. Text, format, and color:
 - 1) Conforming to OSHA 1910.145(d), Specifications for Accident Prevention Sign Design.
 - 2) Text as scheduled below.

- d. Provide eyelet holes at each corner for mounting.
- 3. Text as scheduled below:

Quantity	Text
2	AUTHORIZED PERSONNEL ONLY
2	CAUTION EQUIPMENT STARTS AUTOMATICALLY

B. Fire Equipment Location Signs:

- 1. One-way Fire Equipment Location Signs:
 - a. Manufacturer: Seton Nameplate Company; W.H. Brady Company; or equal.
 - b. Size: 18 inch height (approximate size).
 - c. Material: 60-mil rigid plastic, coated for weather and vandalism protection. Provide eyelet holes at each corner for mounting.
 - d. Text: Bright, fade-resistant red on white downward facing directional arrow on red field. Text is shown on schedule below.
 - e. Schedule of signs required:

Text	Quantity		
	1-way	2-way	3-way
"FIRE EXTINGUISHE R"	2	—	—

C. Security and General Policy Safety (NOTICE) Signs

- 1. Notice (Informational) Signs:
 - a. Manufacturer: Seton Nameplate Company; W.H. Brady Company; or equal.
 - b. Size: 14 inches wide by 10 inches high.
 - c. Material: 60 mil rigid plastic, coated for weather and vandalism protection
 - d. Provide eyelet holes at each corner for mounting.
 - e. Schedule of signs required:

Quantity	Text
2	NOTICE KEEP OUT EMPLOYEES ONLY

2.03 CHEMICAL HAZARD AND HAZMAT COMMUNICATION

A. Chemical Hazard Pictograms

- a. Provide signs in 'diamond' configuration, black pictogram symbol, red sign border with black trim on white background in conformance with OSHA 1910.1200 of the size and quantity noted in the Table, below. Seton L3500 series, or equal.

Sign Type (product number)	Symbol	Material	6"x6"
FLAMMABLE (Seton L3506)		Adhesive Vinyl	3

B. GHS Chemical Signs

1. NFPA Fire Hazards of Materials Signs:
 - a. Seton Nameplate Company; W.H. Brady Company; or equal.
 - b. Sign characteristics: Four-color background, blue, red, yellow, white; diamond shape; 7-1/2 inches by 7-1/2 inches; 3-inch-high black hazard numerals scheduled below; conform to NFPA No. 704, Standard System for the Identification of the Hazards of Materials for Emergency Response.
 - c. Material: Vinyl with adhesive back for tank installation, semi-rigid plastic with adhesive back for exterior mount locations. Where mounted to concrete or other porous materials provide 3/4-inch-thick AB Marine grade Douglas Fir plywood backing, sealed edges, and painted. Eyelet holes at corners for mounting.

2. Schedule of signs required

1 @ Each Tank, 1 @ Exterior Door	Diesel	1	2	0	0
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PART 3 - EXECUTION

3.01 SIGN INSTALLATION

- A. Install signs where directed by the Engineer.
- B. Install signs after painting surfaces to receive signs. Follow manufacturer's written installation instructions.
- C. Use fasteners as follows:
 - 1. To concrete and masonry materials: 4-1/4-inches diameter expansion anchors.
 - 2. To tanks: Adhesive backing.
 - 3. To sheet metal (gauges 28 to 6) #10 sheet metal screws.
 - 4. To plywood backing boards: #10 wood screws.
 - 5. To machinery: Fasteners as suitable.

END OF SECTION

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SECTION 11001
GENERAL EQUIPMENT AND MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

- A. **Section Includes:** The general requirements for all of the Equipment and Mechanical work in the scope of the Project, included in Divisions 11, 13, and 15, and elsewhere wherever specifically mentioned in these Specifications.
- B. Direct the attention of all subcontractors and suppliers of equipment and related appurtenances for the work to the applicable provisions in the Contract Documents wherever they may occur.

1.02 REFERENCES

- A. American Gear Manufacturers Association (AGMA).
- B. American Institute of Steel Construction (AISC).
- C. Hydraulic Institute.
- D. National Electrical Manufacturers Association (NEMA).
- E. Occupational Safety and Health Act (OSHA).
- F. Hawaii Administrative Rules, Title 12, Subtitle 8 (HIOSH).

1.03 STANDARDS FOR THE WORK

- A. **Complete Systems:** Provide pipe, fittings, wiring, and supports to produce complete, operable systems with all elements properly interconnected. If a specific dimensioned location is not shown for interconnections or smaller system elements, select appropriate locations and show them on Shop Drawing submittals for review.
- B. Provide equipment and material new and without imperfections. Erect in a neat and workmanlike manner; aligned, leveled, cleaned and adjusted for satisfactory operation; installed in accordance with the recommendations of the manufacturers and the best standard practices for this type of work so that connecting and disconnecting of piping and accessories can be readily made and so that all parts are easily accessible for inspection, operation, maintenance, and repair. Locate oil and lubrication fittings clear of and away from guards, base, and equipment and within reach from the operating floor.

Coordinate location of all motor connections in order to properly orient encased electrical conduits. In order to meet these requirements with equipment as furnished, minor deviation from the Drawings may be made as favorably reviewed by the Construction Manager.

- C. The recommendations and instructions of the manufacturers of products used in the work are hereby made part of these Specifications, except as they may be superseded by other requirements of these Specifications.

1.04 SUBMITTALS

- A. Shop Drawings: Show sizes and arrangement of equipment, foundations, and anchor bolts required; performance characteristics; pump curves; control diagrams; wiring diagrams; motor data sheets; methods of assembly; pipe hanging details; ductwork layouts; and connections to other work. Date and sign drawings as certified for use in construction of this project. The arrangement of mechanical equipment and appurtenant piping shown on the Drawings may be varied as necessary to fit the favorably reviewed certified manufacturer's installation drawings. However, manufacturers' drawings shall not deviate in substance from the Contract Drawings and Specifications as to location, size, type, and design of equipment. The following minimum requirements shall accompany all equipment submissions:

1. Overall dimensions.
2. Mounting arrangement and dimensions.
3. Description of materials.
4. Connection sizes and orientation.
5. Capacity and location of lifting eyes.
6. Motor arrangement showing location of electrical connections.
7. Rating data - Mechanical and Electrical as applicable.
8. Detail electrical wiring diagrams, showing component designation and rating.
9. Seismic design certifications and anchorage descriptions as required by Section 01190.
10. Motor data as specified in Section 11002.
11. List of special tools and/or spare parts to be furnished, if any.

- B. Each piece of equipment, for which certified witnessed or non-witnessed performance tests are required, shall be accompanied by a completed form containing at least the following information:

1. Owner's name and location of project.
2. Contractor's name and subcontractor if applicable.
3. Name of item being submitted.
4. Specification reference by section, paragraph and page.

5. Data on item (manufacturer, general descriptive data, dimensions, size of connections, speeds, performance curves, serial number). A specific list of the test results plus a list, which shows the values that differ from Specifications.
 6. Motor data, type, voltage, frequency, phase, full load amperes, starting method, frame size, enclosure insulation type (NEMA Code letter), dimensions, service factor, serial number.
 7. Date and signature of person certifying the performance.
- C. Operations and Maintenance Manuals: Prepare and submit manuals covering installation, operation and maintenance of all equipment and machinery specified in Divisions 11, 13, and 15.
- D. Manufacturers' Affidavits: Where called for in the Specifications, each equipment manufacturer, or their authorized representative, shall submit an affidavit conforming to the requirements of Section 01650.

1.05 RESPONSIBILITY AND CARE OF EQUIPMENT

- A. The Contractor shall be responsible for the equipment included in this Contract until it has been finally inspected, tested, and accepted in accordance with the requirements of these Specifications.
- B. The Contractor shall make his own provisions for properly storing and protecting all material and equipment against theft, injury, or damage from any and all causes. Damaged material and equipment shall not be used in the work.

PART 2 - PRODUCTS

2.01 DESIGN

- A. General: Design all equipment for the service intended, of rugged construction, of ample strength for all stresses which may occur during fabrication, transportation, erection, and during continuous or intermittent operation. Adequately stay, brace and anchor, and install equipment in a neat and workmanlike manner. Give consideration to appearance and safety, as well as utility, in the design of details. Use cathodically compatible materials of construction.
- B. Seismic: Refer to Section 01190 of the Specifications for the seismic design criteria.
- C. Controls: Unless noted otherwise, the design of the electric control of any equipment system and/or equipment package shall be the responsibility of the manufacturer of the equipment system and/or equipment package. The

elementary control diagrams as shown on the Electrical Drawings and the diagrams shown on the Instrumentation Drawings are illustrative of control and monitoring requirements pertaining to various equipment of this project. The manufacturers shall design their own functional electric control devices and circuitry, in consultation with the specific elementary control diagrams and other project specifications, to meet the equipment control requirements. All such systems and package controls shall be furnished by the equipment manufacturer, except that controls shown in motor control centers and process controllers, remote control devices, and their interconnecting wiring shall be provided under Divisions 16 and 17. Provide heating, ventilating, and air conditioning controls, both 24-volt and line voltage type, by a HVAC controls specialist.

2.02 MATERIALS AND STANDARD SPECIFICATIONS

- A. Materials: Design, fabricate, and assemble equipment and systems with new materials and in accordance with acceptable modern engineering and shop practices. Manufacture individual parts to standard sizes and gauges so repair parts can be installed in the field.
- B. Uniformity: Unless otherwise specified, equipment or material of the same type or classification used for the same purpose shall be the product of the same manufacturer and shall be the same model.

2.03 LUBRICATION

- A. Provide lubricants of types recommended by equipment manufacturers, in quantities sufficient for consumption prior to completion, testing and final acceptance.

2.04 STRUCTURAL METAL FRAMING

- A. Details of fabrication shall be in accordance with Section 05500.
- B. Weld submerged steel surfaces which butt or bear against each other, to seal the surfaces against the penetration of the liquid. Weld all gaps between adjacent submerged steel surfaces less than 1/32-inch wide to seal the surfaces. Weld size shall be not less than the thickness of the thinnest member of the lapped or joined assembly.

2.05 EQUIPMENT BASES AND BEDPLATES

- A. Mount equipment assemblies on a single heavy cast iron or welded steel bedplate unless otherwise shown or specified. Provide bases and bedplates with machined support pads, tapered dowels for alignment or mating of adjacent items, adequate openings to facilitate grouting, and openings for electrical conduits. Round or chamfer and grind smooth all corners.

Continuously weld seams and contact edges between steel plates and shapes, and grind welds smooth. Do not support machinery or piping on bedplates other than that which is factory installed. Provide jacking screws in equipment bases and bedplates to aid in leveling prior to grouting. Mount all equipment bases and baseplates on reinforced concrete pads at least 3 inches high.

2.06 ANCHORS

- A. Each equipment manufacturer shall furnish an anchor bolt pattern and the required anchor bolts, nuts, and washers of adequate design for securing bases and bedplates to concrete bases. Provide anchor bolts of length to allow for 1-1/2-inch of grout under baseplates and adequate anchorage into structural concrete unless otherwise shown or specified.
- B. Provide anchor and assembly bolts and nuts of ample size and strength for the purpose intended. All bolts shall be standard machine bolts, with cold pressed hexagon nuts. Provide suitable degauling compounds for bronze and stainless steel threaded components. Any space wholly or partially underground, or having a wall or ceiling forming part of a water channel, is classified as a moist location. Unless otherwise specified or noted on the Drawings, provide materials as follows:
 1. Bolts and nuts in submerged locations or submerged and embedded in concrete or buried in earth: Type 316 stainless steel.
 2. Bolts and nuts for supports or equipment in dry or moist locations: Galvanized steel (hot-dipped), with oversize nuts.
 3. Use other bolting materials where specifically called for in the Specifications or on the Drawings.
- C. Anchor all motor-driven equipment with cast-in-place anchor bolts or drilled-in anchors set with epoxy adhesive. Do not provide expansion type anchors for motor-driven equipment.
- D. Anchor all non-motor-driven equipment with cast-in-place anchor bolts or drilled-in anchors set with epoxy adhesive except that, where specifically allowed by note on the Drawings, expansion type anchors may be used.
- E. Refer to Section 05500 for technical specification requirements for cast-in-place and post-installed anchors.

2.07 LIFTING EYES

- A. Supply all equipment weighing over 100 pounds with lifting eyes. Parts of equipment assemblies which are normally serviced separately, such as motors, to have lifting eyes of their own.

2.08 DRIVES

- A. General: Provide all drive units with an AGMA rating and service factor suitable for 24 hours per day operation under the operating load.
- B. Electric Motors: Conform to the requirements of Section 11002.
- C. V-Belt Drives: Equip each V-belt drive with suitable tension adjustment. Provide drives having a service factor of at least 1.6 with arc length correction at maximum torque using nameplate rating of driving motor.

2.09 NAMEPLATES

- A. Manufacturer's Nameplate: Furnish each piece of equipment and its driver with a corrosion-resistant metal nameplate fastened to the item in a readily readable position. This nameplate to contain the manufacturer's name, equipment rating, capacity, size, model, serial number, and speed. All information written or printed to be in English.
- B. Direction of Rotation: Furnish each piece of rotating equipment with a direction of rotation arrow.
- C. Functional Identification: Label each piece of equipment using a plastic laminate label with the functional name and number of the equipment.
 - 1. Fasten labels to the equipment, its base, or other acceptable location:
 - a. Letters: At least 1/2-inch high with the border trim on all sides not less than 1/4-inch.
 - b. Color: Green background with white letters.
 - c. Fasteners: Brass or stainless steel screwed into inserts, anchor shields, or tapped holes in equipment or base.

2.10 PROTECTION AGAINST ELECTROLYSIS

- A. Where dissimilar metals are used in conjunction with each other, provide suitable insulation between adjacent surfaces so as to eliminate direct contact and any resultant electrolysis. Connections of dissimilar piping materials shall utilize dielectric unions, flanges, couplings, or bushings.

2.11 SPECIAL TOOLS

- A. For each type of equipment to be furnished, provide a complete set of all special tools (including grease guns or other lubricating devices) which may be necessary for the adjustment, operation, and maintenance of such equipment.

2.12 FINISHES

- A. Conform to applicable requirements of Section 09960.
- B. **Factory Painting:** On pumps, motors, drives, starters, control panels, and other similar self-contained or enclosed components, apply a factory protective paint system unless otherwise noted. Paint or otherwise protect surfaces that are inaccessible after assembly by a method which provides protection for the life of the equipment.
- C. **Shop Priming:** Except where field sandblasting is required, apply one or more shop coats of metal primer on surfaces to be finish painted at the site, of sufficient thickness to protect surfaces until finished. Primer shall be compatible with finish coat.
- D. **Rust Preventive:** Coat machined, polished, other ferrous surfaces, and non-ferrous surfaces which are not to be painted with rust preventive compound.

2.13 NOISE AND VIBRATION

- A. Mechanical and electrical equipment, as installed in this project, shall not create sound levels in excess of that permitted by OSHA/HIOSH for 8 hours per day worker exposure. If the required sound level cannot be achieved by bare equipment in its designated environment, provide sound attenuating enclosures. Sound attenuating enclosures shall have necessary ventilation to prevent equipment overheating and shall be constructed for easy removal to permit maintenance. Devices necessary for day-to-day operation shall pierce the enclosure or otherwise be accessible without need to remove the enclosure.
- B. Equipment which when operating has obvious excessive vibrations shall be repaired or replaced as directed by the Construction Manager. Baseline vibration measurements shall be made where specified.

2.14 FACTORY TESTS

- A. Perform factory tests for each piece of equipment where specifically called for in the section specifying that equipment. Note that factory tests are inherent in many reference standards. The requirement for a factory test in a referenced standard is hereby made a part of these Specifications. Conduct factory tests at the same speeds and other conditions at which the equipment will operate in the field, except as noted.
- B. Where specifically noted, performance tests may be witnessed by the Construction Manager or his representative. Inform the Construction Manager in sufficient time to allow arrangements to be made for witness of such tests. When non-witnessed tests are performed, supply certified results.

- C. Perform factory testing of pumps in accordance with the requirements and standards of the Hydraulic Institute.
- D. Tests of other equipment shall conform to the requirements set forth in these Specifications.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Inspect each item of equipment for damage, defects, completeness, and correct operation before installing.

3.02 PREPARATION

- A. Prior to installing equipment, ensure that the areas are clean. Maintain the areas in a broom-clean condition during installation operations. Clean, condition, and service equipment in accordance with the approved Instruction Manuals and specific recommendations of the equipment manufacturer.

3.03 INSTALLATION

- A. Structural Fabrications: Conform to the AISC Code and Specification referenced in Article "Structural Steel Fabrications," and conform to Section 05500.
- B. Equipment: Conform to approved Operations and Maintenance Manuals. Employ skilled craftsmen experienced in installation of the types of equipment specified. Use specialized tools and equipment, such as precision machinist levels, dial indicators, gauges, and micrometers, as applicable. Produce acceptable installations free of vibration or other defects. Align and pin to common bedplate equipment and drivers connected by flexible couplings.
- C. Anchor Bolts: Deliver bolts with templates or setting drawings and verify that bolts are correctly located before structural concrete is placed.
- D. Base and Bedplate Grouting: Do not place grout until initial fitting and alignment of connected piping is completed. Level and align equipment on the concrete foundations, then entirely fill the space under base or bedplates with grout. Bevel exposed grout at 45-degree angle, except round exposed grout at horizontal surfaces for drainage. Trowel or point exposed grout to a smooth, dense finish and damp cure with burlap for 3 days. When grout is fully hardened, remove jacking screws and tighten nuts on anchor bolts. Check the installation for alignment and level, and perform approved corrective work as required to conform to the tolerances given in the applicable Instruction Manual.

1. Make an allowance of at least 1-1/2 inches for grout under the equipment bases, whether or not shown on the Drawings. Use steel shims to level and adjust the bases. Shims may be left embedded in the grout, in which case they shall be installed neatly and so as to be as inconspicuous as possible in the completed work. Unless otherwise approved, all grout shall be a favorably reviewed non-shrink, non-metallic grout.
 2. Grout: Dimensionally stable, inorganic, premixed and resistant to acids, alkalies, and salt water, and unaffected by water and oil. It shall have high strength even when used as a pourable mixture, and shall bond well with steel and cured concrete or be compatible with a suitable bonding agent which shall then be used to effect the bond. Use in strict accordance with the manufacturer's recommendations. Provide Five Star Grout as manufactured by U.S. Grout Corporation, Bonsal Construction Grout as manufactured by Bonsal Company, or equal. Submit for favorable review by the Construction Manager prior to use.
 3. Where practicable, place the grout through the grout holes in the equipment base and work outward and under the edges of the base and across the rough top of the concrete foundation to a peripheral form so constructed as to provide a suitable chamfer around the top edge of the finished foundation.
- E. Architectural Metals: Handrails, guardrails, stairs, and other architectural metals furnished as a part of equipment shall conform to the requirements of Division 5.

3.04 EQUIPMENT STARTUP AND ADJUSTMENT

- A. Arrange for an authorized factory-trained representative of the company or companies supplying the various items of equipment to check the installation and adjust and test the equipment. Said representative shall be experienced and knowledgeable of the equipment being tested. Furthermore, the representative shall assist and instruct the operating staff in adjusting and operating the equipment during the initial plant operation period.
 1. Provide initial lubrication for all equipment.
 2. Test and demonstrate to the Construction Manager that all equipment operates properly and specified performance has been attained. For pumps, include measurement of suction and discharge pressure at the pump and measurement of pumping rate by volumetric means or through a suitably calibrated meter for two points on the performance curve. For adjustable-speed pumps, conduct tests at a minimum of two speeds. Furnish any test equipment or measuring devices required which are not part of the permanent installation.
 3. In addition, demonstrate that the entire facility is in full operating condition prior to the acceptance of the work. Should any equipment or

- part thereof fail to operate as intended, immediately remove and replace it, all at the Contractor's expense. Pay for all tests involved in this Section.
4. Pressure test equipment and connection as required by these Specifications.

3.05 PERFORMANCE TESTS

- A. Upon completion of the work, and after all systems are set and balanced, conduct performance tests in accordance with Section 01660 – Testing and Commissioning and other applicable sections of these Specifications. Submit test conditions, test data and results to the Construction Manager for review.

3.06 SOUND LEVEL TESTING

- A. Measure the sound level developed by all mechanical and electrical equipment provided. Perform testing during the final operation test program with all equipment operating. Use OSHA approved instrument and record the highest sound level developed when measured according to OSHA standards in each room and space. Deliver a copy of records to the Construction Manager.

3.07 TOOLS, LOOSE PARTS, AND LUBRICANTS

- A. Tools and Loose Parts Supplied: Provide an inventory of tools and loose parts required to be supplied under the project. Turn over inventory and parts to the Construction Manager. The Construction Manager's written acknowledgment of receipt is required for project completion. Loose parts are defined as items such as special tools, keys, safety equipment, and portable equipment. Refer to Section 01700 and relevant technical sections for additional instructions.
- B. Recommended Spare Parts: Furnish a complete list of recommended spare parts and supplies for each equipment furnished with current prices and supply source.
- C. Provide a list of all recommended lubricants not listed in the Operations and Maintenance Manuals.

END OF SECTION

SECTION 11002
ELECTRIC MOTOR DRIVES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Provide motors to drive equipment specified in other sections and Divisions, including, but not limited to, Divisions 11, 13, and 15. Refer to driven equipment sections for additional requirements. Requirements of the driven equipment Specifications shall take precedence over the requirements of this Section, where conflict occurs. This Section applies to all electric motors furnished for this project, unless otherwise noted.

1.02 REFERENCE STANDARDS

- A. NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA) STANDARD:
1. MG 1 Motors and Generators
- B. INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE) STANDARD:
1. 112 Test Procedure for Polyphase Induction Motors and Generators
- C. Underwriters Laboratories (UL) Publication: Recognized Component Directory

1.03 SUBMITTALS

- A. For each motor, include the following data in the shop drawing submittal for the driven equipment, as part of the driven equipment's Product Review submittals:
1. Machine name and specification number of driven machine
 2. Manufacturer's name.
 3. Motor model and dimension drawing, including motor weight.
 4. Manufacturer's type and frame designation.
 5. Nominal Horsepower output.
 6. Time rating.
 7. Maximum ambient temperature rating.
 8. Winding Insulation class and temperature rise class.
 9. RPM at full load.
 10. Voltage, number of phases, frequency and full load amperes.
 11. Code letter for locked rotor kVA.

12. Service factor at 40°C ambient.
 13. NEMA design letter.
 14. Enclosure type.
 15. Bearing data including lubrication requirements, type and frequency.
 16. KW input power and power factor at 75% and 100% of rated horsepower output.
 17. Guaranteed minimum full load efficiency. Also, nominal efficiencies at 1/2 and 3/4 load.
 18. Type of thermal protection or overtemperature protection, if included.
 19. Wiring diagram for devices such as motor leak detection, temperature or zero speed switches, as applicable.
 20. If utilized with a variable frequency controller, verify motor is inverter duty type. Include minimum speed at which motor may be operated for the driven machinery. Provide shaft grounding information and details.
 21. Power factor at 1/2, 3/4 and full load.
 22. Recommended size for power factor correction capacitors to improve power factor to 0.95% lagging when operated at full load.
- B. If water cooling is required for motor thrust bearings, the Shop Drawing submittals shall indicate this requirement.

1.04 COORDINATION

- A. General: Coordinate motors with driven equipment requirements. Unless otherwise specified, equipment manufacturers or suppliers shall select and provide motors for their equipment in conformance with these Specifications. Give particular attention to coordination of requirements for:
1. Power.
 2. Starting torque.
 3. Speed.
 4. Bearing load.
 5. Ambient temperature.
 6. Frequency of starting.
 7. Moisture exposure.
 8. Adjustable speed control, where applicable.
- B. Suppliers of motors to be used with adjustable speed systems shall:
1. Provide all relevant motor data to the adjustable speed control manufacturer for analysis. Provide motors in conformance with and compatible with the adjustable speed control manufacturer's equipment and requirements.
 2. Provide all relevant motor data to the pump manufacturer for vibration, reed critical frequency and other required analyses.

1.05 SPECIFIC REQUIREMENTS

- A. The following motor characteristics are specified with the driven equipment in all cases:
 1. Speed.
 2. Horsepower or supplier responsibility to determine.
 3. Horizontal or vertical arrangement.
 4. Indoor or outdoor location.
- B. Additional motor characteristics are specified with the driven equipment only where the required motor differs from the typical characteristics described below or where additional properties or characteristics are required that are not specified in this Section.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Motors shall be designed, built, and installed in the driven equipment, to provide long, trouble-free life in industrial service and shall be rated in conformance with NEMA MG-1. Motors rated 100-horsepower or less and rated 600V or less shall be listed in UL Recognized Component Directory or shall be listed and labeled by other organizations acceptable to the authority having code enforcement jurisdiction.
- B. Unless otherwise specified with the driven equipment, provide motors with the following typical characteristics:
 1. NEMA Design: Electric motors shall be NEMA Design B unless otherwise indicated. In no case shall starting torque or breakdown torque be less than the value in NEMA MG-1. Motors shall be suitable for the indicated starting method.
 2. Voltage Ratings:
 - a. $\frac{1}{2}$ -horsepower or less: 115 volts, single-phase, 60 Hz, capacitor start. Small fan motors may be split phase or shaded pole type if standard for the equipment. Dual voltage motors rated 115/230 volts, 115/208 volts, or 120-240 volts are acceptable, provided leads are brought out to the conduit box.
 - b. Above $\frac{1}{2}$ -horsepower: 460 volts, three-phase, 60 Hz, squirrel cage induction motors. Dual voltage motors rated 230/460 volts, or 208/230/460 volts are acceptable, provided every lead is brought out to the conduit box.
 3. All motors shall have a service factor of 1.15 in an ambient temperature of 40°C.

- a. Exceptions: Motors, which have special enclosures or winding configurations, may carry a Unity (1.0) Service Factor. Examples are totally enclosed, explosion proof, or submersible motors.
 - 4. Windings shall be copper.
 - 5. Horizontal motors 3-HP and larger and every vertical motor shall have split-type cast metal conduit boxes. Motors shall be provided with oversized conduit boxes. Motors other than open drip-proof shall be gasketed.
 - 6. Provide ground lug inside the terminal box.
 - 7. Provide lifting eye on each motor weighing more than 50 pounds.
 - 8. Each motor shall be suitable for six starts per hour (5 minutes on and 5 minutes off, continuously) when powering the specific driven equipment required for this project.
 - 9. Each motor shall have an overall sound power level at no load not greater than given in NEMA MG1-Part 9.
 - 10. Inverter duty motors shall be provided with shaft grounding rings. Rings shall be factory installed, and shall be by Aegis, or equal. The motor warranty shall include coverage against VFD-induced bearing damage or failure.
 - 11. Motors, which have special operating characteristics such as multi-speed, high torque/high slip, short time intermittent ratings shall be nameplated to show how these characteristics differ from standard design.
- C. Motors used with variable frequency drives shall have inverter duty complying with NEMA MG-1, Section IV, Part 31, and shall be clearly identified as "Inverter Duty."
- D. Increased circuit breaker, magnetic starter, and conductor and conduit capacities required for motors larger than the indicated sizes shall be provided as part of the Contractors work.
- E. Two speed motors shall be of the two-winding type.
- F. **Exempt Motors:** Motors for valve operators, submersible pumps, or motors which are an integral part of standard manufactured equipment, i.e., non-NEMA mounting, common shaft with driven element, or part of domestic or commercial use apparatus may be excepted from these requirements to the extent that such variation reflects a necessary condition of motor service or a requirement of the driven equipment.

2.02 NAMEPLATE

- A. Provide stainless steel nameplate for each motor, attached to the motor by stainless steel screws or drive pins. Nameplates shall indicate clearly the information required by NEMA MG1, Part 10 and Part 12.

2.03 ENCLOSURE TYPE BY LOCATION

- A. Unless otherwise specified with the driven equipment, provide motors with the following typical enclosures:
 1. Indoors and non-hazardous: Horizontal motors shall be open, drip-proof; vertical motors shall be drip-proof with guard.
 2. Outdoors and non-hazardous: Vertical motors shall be weather-protected Type I. Horizontal motors shall be totally enclosed, fan cooled. All motors shall have the following features:
 - a. Bearing protection.
 - b. Anti-corrosion treatment of external hardware and internal metal parts.
 - c. Weatherproof terminal box with gaskets between the motor, terminal box, and terminal box cover.
 - d. Guard screens on ventilation openings.
 - e. Moderate moisture-resistant insulation specified hereinafter.
 - f. Interior and exterior corrosion protection coatings.
- B. Special attention to leads into terminal box. When specifically called for in the Specifications for the driven equipment or required by Code, provide the following enclosure types:
 1. Hazardous locations: Motors for use in hazardous locations shall have enclosures suitable for the classification indicated. Such motors shall be U.L. listed and be stamped as such.
 2. Severe duty: Motors shall have the following features:
 - a. Totally enclosed, fan cooled enclosure.
 - b. Stainless steel nameplate.
 - c. Cast iron housing, bearing brackets, and fan guard.
 - d. Cast iron conduit box with threaded conduit entrance.
 - e. Corrosion resistant fan.
 - f. Corrosion resistant hardware.
 - g. Automatic breather/drain.
 - h. Ground lug.
 - i. Regreasable bearings.
 - j. Provision for excluding water and dust from bearings.
 - k. Class F insulation.
 - l. Service factor of 1.15.
 - m. Epoxy coating on all external surfaces.
 3. Submersible: Submersible motors shall comply with the following:
 - a. Air-filled squirrel cage induction type.
 - b. Service factor of 1.15 or better.
 - c. Class F insulation, Class B temperature rise.
 - d. Rated for six (6) starts per hour.
 - e. Listed by either UL or FM for Class 1, Division 1, Groups C and D hazardous locations.

- f. Suitable for operating in free air continuously (i.e., not submerged in sewage).
- g. Bearing B10 life 18,000 hours minimum.
- h. Tungsten carbide seals.
- i. Lower bearings of either the ball or roller type.
- j. If required by the manufacturer to not void the motor warranty, provide a moisture detection system and a motor winding thermostat system. These systems shall be complete, including all necessary interfaces, control panels, conduits, and wires, even though these may not be shown on the Drawings.

2.04 INSULATION

- A. Three-phase motors shall be provided with Class F insulation, rated to operate at a maximum ambient temperature of 40° C and at the altitudes where the motors will be installed and operated, without exceeding Class B temperature rise limits stated in NEMA MG 1-12.44. Single phase motors shall have Class F insulation with temperature rise not to exceed the insulation class. Motors to be operated from adjustable frequency drives shall be provided with insulation systems to withstand 1600-volt spikes, with dV/dT as defined in NEMA MG 1-31. The adjustable frequency drive manufacturer shall coordinate with the motor manufacturer to determine when additional dV/dT protection is required. Where required, it shall be furnished and installed as per the manufacturer's written instructions.
- B. Where called for in the Specifications for the driven equipment, provide the following type of insulation:
 - 1. Moderate Moisture Resistant: Provide extra dip and bake of epoxy or polyester varnish to resist somewhat higher than normal moisture in the atmosphere.

2.05 MOTOR HORSEPOWER

- A. The maximum permissible motor loading:
 - 1. Motors with service factor 1.15 or greater: 100% of nameplate horsepower.
 - 2. Motors with service factor less than 1.15: 90% of nameplate horsepower.
- B. Probable motor horsepower ratings have been specified or shown on the Drawings. Changes from the specified horsepower may be accepted, if necessary, to assure that motors do not exceed their maximum permissible loading, as defined above, under normal operation. Motor horsepowers shall not be less than those specified in driven equipment sections. If a larger horsepower rating is required by the driven equipment, provide all changes

required to motor starting and control equipment and to the conduit and wiring system without any additional cost to the County.

2.06 EFFICIENCY

A. FOR MOTORS 1-HORSEPOWER AND LARGER:

1. Provide NEMA premium efficient units. Motors shall be stamped with the efficiency on the nameplate with the caption "NEMA Nominal Efficiency" or "NEMA Nom. Eff." Premium efficiency motors shall have nominal and minimum efficiencies at full load not less than those listed in Table 11002-1. Both efficiencies shall be included in the Shop Drawing submittal.
- B. Efficiencies shall be determined by using the IEEE 112, Test Method B using segregated loss determination.
- C. Single-phase fractional horsepower motors $\frac{1}{4}$ -HP through $\frac{3}{4}$ -HP motors shall be high-efficiency split-capacitor types having minimum efficiency ratings of not less than 64% and power factors of not less than 94.5%

TABLE 11002-1

OPEN DRIP-PROOF (ODP)						
FULL-LOAD EFFICIENCIES OF NEMA PREMIUM EFFICIENCY MOTORS RATED 600 VOLTS OR LESS						
	2-POLE		4-POLE		6-POLE	
HP	Nom. Effic.	Min. Effic.	Nom. Effic.	Min. Effic.	Nom. Effic.	Min. Effic.
1	77.0	74.0	85.5	82.5	82.5	80.0
1.5	84.0	81.5	86.5	84.0	86.5	84.0
2	85.5	82.5	86.5	84.0	87.5	85.5
3	85.5	82.5	89.5	87.5	88.5	86.5
5	86.5	84.0	89.5	87.5	89.5	87.5
7.5	88.5	86.5	91.0	89.5	90.2	88.5
10	89.5	87.5	91.7	90.2	91.7	90.2
15	90.2	88.5	93.0	91.7	91.7	90.2
20	91.0	89.5	93.0	91.7	92.4	91.0
25	91.7	90.2	93.6	92.4	93.0	91.7
30	91.7	90.2	94.1	93.0	93.6	92.4
40	92.4	91.0	94.1	93.0	94.1	93.0
50	93.0	91.7	94.5	93.6	94.1	93.0
60	93.6	92.4	95.0	94.1	94.5	93.6
75	93.6	92.4	95.0	94.1	94.5	93.6
100	93.6	92.4	95.4	94.5	95.0	94.1
125	94.1	93.0	95.4	94.5	95.0	94.1
150	94.1	93.0	95.8	95.0	95.4	94.5
200	95.0	94.1	95.8	95.0	95.4	94.5
250	95.0	94.1	95.8	95.0	95.4	94.5
300	95.4	94.5	95.8	95.0	95.4	94.5
350	95.4	94.5	95.8	95.0	95.4	94.5
400	95.8	95.0	95.8	95.0	95.8	95.0
450	96.2	95.4	96.2	95.4	96.2	95.4
500	96.2	95.4	96.2	95.4	96.2	95.4

Source: NEMA MG1 - 2011, Table 12-12

TOTALLY ENCLOSED - FAN COOLED (TEFC) FULL-LOAD EFFICIENCIES OF NEMA PREMIUM EFFICIENCY MOTORS RATED 600 VOLTS OR LESS						
	2-POLE		4-POLE		6-POLE	
HP	Nom. Effic.	Min. Effic.	Nom. Effic.	Min. Effic.	Nom. Effic.	Min. Effic.
1	77.0	74.0	85.5	82.5	82.5	80.0
1.5	84.0	81.5	86.5	84.0	87.5	85.5
2	85.5	82.5	86.5	84.0	88.5	86.5
3	86.5	84.0	89.5	87.5	89.5	87.5
5	88.5	86.5	89.5	87.5	89.5	87.5
7.5	89.5	87.5	91.7	90.2	91.0	89.5
10	90.2	88.5	91.7	90.2	91.0	89.5
15	91.0	89.5	92.4	91.0	91.7	90.2
20	91.0	89.5	93.0	91.7	91.7	90.2
25	91.7	90.2	93.6	92.4	93.0	91.7
30	91.7	90.2	93.6	92.4	93.0	91.7
40	92.4	91.0	94.1	93.0	94.1	93.0
50	93.0	91.7	94.5	93.6	94.1	93.0
60	93.6	92.4	95.0	94.1	94.5	93.6
75	93.6	92.4	95.4	94.5	94.5	93.6
100	94.1	93.0	95.4	94.5	95.0	94.1
125	95.0	94.1	95.4	94.5	95.0	94.1
150	95.0	94.1	95.8	95.0	95.8	95.0
200	95.4	94.5	96.2	95.4	95.8	95.0
250	95.8	95.0	96.2	95.4	95.8	95.0
300	95.8	95.0	96.2	95.4	95.8	95.0
350	95.8	95.0	96.2	95.4	95.8	95.0
400	95.8	95.0	96.2	95.4	95.8	95.0
450	95.8	95.0	96.2	95.4	95.8	95.0
500	95.8	95.0	96.2	95.4	95.8	95.0

2.07 MOTOR THERMAL PROTECTION

- A. Single Phase Motors: Single phase 120, 208, or 230 volt motors shall have integral thermal overload protection or shall be inherently current limited.
- B. In each motor to be used with adjustable speed drives, in all motors 60-horsepower and larger, or where called for in the Specifications for the driven equipment, provide integral thermostats or other approved devices to protect the motor from overheating. Thermostats shall be snap action, bi-metallic, temperature actuated switch. Thermostats shall be normally

closed, and the switch point shall be precalibrated by the manufacturer. Thermostats shall be rated 125-Vac, 1-amp.

2.08 SPACE HEATERS

- A. On all outdoor motors, where called for in the Specifications for the driven equipment, or where shown on the Drawings provide space heaters or solid state motor winding heating systems for motors. Heaters shall be 120 or 240 volts, single-phase, as required by the control circuit voltage. Heater wattage and voltage ratings shall be indicated on motor nameplate.

2.09 MOTOR BEARINGS

- A. General: Bearings shall conform to Section 11001 – General Equipment and Mechanical Requirements, except as indicated herein.
- B. Motors greater than 2-HP shall have bearings designed for 17,500 hours (belted) or 100,000 hours (coupled) L-10 life.
- C. Fractional Horsepower: Motors with fractional horsepower through 2-HP shall be provided with lubricated-for-life ball bearings.
- D. Horizontal Motors Over 2-HP: Motors larger than 2-HP shall be provided with relubricatable ball bearings. Lubrication shall be per manufacturer's recommendation for smooth operation and long life of the bearings.
- E. Vertical Motors Over 2-HP: Vertical motors larger than 2-HP shall be provided with relubricatable ball, spherical, roller, or plate type thrust bearings. Lubrication shall be per manufacturer's recommendation for smooth operation and long life of the bearings.
- F. Inverter Duty Motors: Provide an insulated bearing to prevent circulating bearing currents.

2.10 MANUFACTURERS, OR APPROVED EQUAL

- A. U.S. Motors
- B. General Electric
- C. WEG

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install motors in driven equipment in conformance with motor manufacturer's recommendations and requirements. Motor nameplate shall be visible when

- installed on the driven equipment. Where applicable, shaft grounding devices shall be connected to the grounding system in accordance with the manufacturer's recommendations.
- B. Related electrical WORK involving connections, controls, switches, and disconnects shall be performed in accordance with the applicable sections of Division 16.

3.02 FACTORY TESTS

- A. Motors shall be factory tested in conformance with IEEE 112, IEEE 43 - Recommended Practice for Testing Resistance of Rotating Machinery, and NEMA MG-2. Except where specific testing or witnessed shop tests are required by the specifications for driven equipment, factory test reports may be copies of routine test reports of electrically duplicate motors. Test report shall indicate test procedure and instrumentation used to measure and record data. Test report shall be certified by the motor manufacturer's test personnel and be submitted to the Engineer.

3.03 FIELD TESTING

- A. The Contractor shall perform the following field tests:
1. Inspect each motor installation for any deviation from rated voltage, phase, frequency, and improper installation.
 2. Visually check for proper phase and ground connections. Verify that multi-voltage motors are connected for proper voltage. Verify shaft grounding devices are properly grounded.
 3. Check winding and bearing temperature detectors and space heaters for functional operation.
 4. Test for proper rotation prior to connection to the driven equipment.
 5. Visually check that motor overload heaters are properly sized and that MCP breaker settings are correct for the motor installed.
 6. Test insulation (megger test) of new motors in accordance with NEMA MG-1. Test voltage shall be 1000 VAC plus twice the rated voltage of the motor.

END OF SECTION

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SECTION 11303

SUBMERSIBLE WASTEWATER PUMPS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Furnish complete, tested and operating, submersible wastewater pumps, as shown on the Drawings and as specified herein.

1.02 REFERENCES

- A. Hydraulic Institute Standard 14.6 – Rotodynamic Pumps for Hydraulic Performance Acceptance Tests.

1.03 SUBMITTALS

- A. Shop Drawings: The Contractor shall submit shop drawings for favorable review of the pumps and accessories. Include sufficient data to show that equipment conforms to Specification requirements as indicated herein and in Related Sections. Submit per Section 01300 in a single complete initial package under the Product Review category. Include the following:

1. Pump and motor product and performance data, including a prototype pump performance curve for each application and indicate minimum continuous stable flow (MCSF). Indicate impeller trim. Submit certification that pumps and motors are suitable for adjustable speed service. Submit adjustable speed performance curves covering the range from full speed to manufacturer's recommended minimum speed. Indicate minimum continuous stable flow (MCSF) for all speeds.
2. Typical wet well installation drawings indicating dimensions and minimum clearances.
3. Guide rail and other accessory data.
4. Davit crane product and dimensional data.

- B. Manuals: The Contractor shall furnish manufacturer's installation, lubrication, operation and maintenance manuals, bulletins, and spare parts lists.

- C. Affidavits: The Contractor shall furnish affidavits from the manufacturer stating that the pumps have been properly installed and tested and each is ready for full time operation.

- D. Performance Testing: Certified non-witnessed factory performance tests in accordance with Hydraulics Institute Standard 14.6 are required for each pump shall be not less than Grade 1U unless noted elsewhere in this

specification. Obtain favorable review from the Construction Manager prior to shipment of the pumps.

1.04 QUALITY ASSURANCE

- A. All equipment furnished under this Section shall: 1) be of a manufacturer who has been regularly engaged in the design and manufacture of the equipment for at least 5 years; and 2) be demonstrated to the satisfaction of the Construction Manager that the quality is equal to equipment made by those manufacturers specifically named herein.

PART 2 - PRODUCTS

2.01 SUBMERSIBLE WASTEWATER PUMPS

- A. General: All pumps shall be heavy-duty, submersible, non-clog, centrifugal, quick disconnect wastewater pumps. The pumps shall be capable of operating in the range of capacity specified on a continuous basis with no detrimental effects to the pump or motor.

- B. Pump Schedule: The pump operating characteristics shall be as follows:

Parameter	Pumps (P-001, 002, 003)
Primary Point at Full Speed (gpm @ TDH)	1,000 @ 133 ft
Maximum Capacity at Full Speed (gpm @ TDH)	1,272 @ 108 ft
Minimum Capacity at Full Speed (gpm @ TDH)	742 @ 152 ft
Secondary Point 2 pumps operating (gpm @ TDH)	1,799 @ 149 ft
Minimum Shutoff Head	210 feet
Maximum Synchronous Speed	1800 rpm
Pump Drive Type	Adjustable Speed
Minimum Operating Speed	1200 rpm
Motor Horsepower	60 HP
Required minimum efficiency at Primary Point	71.3%
Minimum Solids sphere passage	3 inches
Minimum Size Discharge (inches)	4 inches
Discharge pressure gauge range (see Section 15050)	0 to 100 psig
Manufacturer and Model No.	Flygt NP3202 HT3 ~467

C. PUMP CONSTRUCTION:

1. General:

- a. The pumps shall be designed to permit sump-top removal of pumping units from the wet well for inspection or service without

- disconnecting or disturbing the discharge piping. The pump connection shall be metal to metal. The design shall permit the pumps when lowered into place to be automatically connected to the discharge piping by positively locking the volute in position to prevent any axial or lateral movement. There shall be no need for personnel to enter the wet well when pump inspection or service is required.
- b. Pump assembly, including motor, pump, and cable accessories must be rated for Class 1, Division 1 hazardous environment, explosion proof, Groups C and D.
 - c. Lifting assemblies and discharge mating flanges shall be spark proofed, Factory Mutual or UL Standards.
2. Pump Castings: Castings shall be of cast-iron or semi-steel of uniform quality and free from blowholes, porosity, hard spots, shrinkage defects, cracks and other injurious defects. The casings shall be designed to permit replacement of wearing parts. Joints shall be properly sealed with O rings and shall not leak under a test pressure equal to 50% greater than the pump discharge pressure or the total dynamic head, whichever is greater. Passageways shall permit smooth flow and shall be free from sharp turns and projections.
 3. Impellers: Impellers shall be of cast-iron, cast-steel, or an alloy suitable for the service required. The impellers shall be smooth and free flowing and shall have sufficient clearance to permit objects in the sewage that enter the pump to pass into the discharge pipe. Each impeller shall be accurately fitted and keyed, splined, or threaded on the shaft, and locked in such a manner that lateral movement will be prevented and reverse rotation will not cause the impeller to loosen. The impeller to volute clearance shall be adjustable by the means of a single trim screw.
 4. Balance: All rotating parts of the equipment shall be in such balance, mechanically and hydraulically, as to operate throughout the required range without excessive end thrust, vibration, or noise.
 5. Shafts: Shafts shall be stainless steel, shall be of sufficient size and strength to perform the work required, and shall be adequately provided with alignment bearings.
 6. Bearings: Bearings subject to submersion shall have a minimum L-10 life of 50,000 hours.
 7. Mechanical Seals: Each pump shall be equipped with tandem independently-mounted tungsten carbide seals. The cavity between the seals shall be filled with lubricating oil.
 8. Electrical Motors: Submersible, 60-Hertz, air filled, inverter duty rated for variable-speed applications. Motor shall be capable of continuous operation over the entire range of operating liquid levels shown on the Drawings and in the Specifications. See Section 11002 for detailed motor specifications. Rated motor horsepower shall be non-overloading throughout the entire pump curve.
 9. Pump and motor protection:

- a. Provide the following devices for each pump:
 - 1) Moisture detection probe between the mechanical seals.
 - 2) Thermal sensors embedded in the motor windings.
 - 3) Additional devices as required to be compatible with the pump monitoring and control system.
 - b. Relays for the protection devices shall be provided by the pump manufacturer or shall be guaranteed by the Contractor to be compatible with each pump in accordance with the pump manufacturer requirements. Install in the pump starter enclosure.
 - c. The thermal switches and float switch shall be connected to a Mini CAS control and status monitoring unit. The Mini CAS unit shall be designed to be mounted in the pump control panel.
10. Shop Coating: Pump, motor, and accessories shall be factory applied and finish coated in accordance with the manufacturer's standard.

2.02 ACCESSORIES

- A. Piping, Fittings, and Appurtenances: Each pump shall be furnished with quick-disconnect discharge elbow, two Schedule 40 pipe rails, upper guide rail bracket, intermediate guide rail bracket, rail-guided lifting assembly, and stainless steel chain of sufficient strength to raise and lower pump. All guide rail components and fasteners shall be Type 316 stainless steel except for non-ferrous items as required for spark proofing. Provide intermediate guide rail support brackets as recommended by the pump manufacturer. Guide cable system of stainless steel will be acceptable in lieu of pipe rails.
 - 1. Each pump shall be provided with 18 inches of lifting chain connected to the pump. Lifting cable shall be connected to the end of the lifting chain. The lifting cable shall be of sufficient length to extract the pump from the installation. Both the lifting chain and lifting cable shall be Type 316 stainless steel. Ends of the lifting chain and one end of the lifting cable shall be provided with shackles for connecting. The other end of the lifting cable shall have a loop for hooking on the cable holder. The loop shall fit through the large eye of the Grip-Eye.
 - 2. Provide a Type 316 stainless steel cable holder.
 - 3. Furnish each submersible pump with a stainless steel Grip-Eye for use with a mechanical lifting device. Grip eye shall be appropriately sized for weight of pump to be lifted and size of lifting chain.
- B. Access Frame and Cover: Provide aluminum access hatches and accessories for pump installations as shown on the Drawings in accordance with Section 08307.
- C. Pressure Gauges: Provide discharge pressure gauges for each pump with features and accessories in accordance with Section 15050. Gauge range is indicated in the Pump Schedule.

D. MISCELLANEOUS MATERIALS:

1. Bolts, nuts, anchors, washers, and all other types of supports necessary for the installation of the pumps, drive units, and all other accessories within the wet well shall be furnished and shall be of Type 316 stainless steel.
2. Elastomers: Nitrile (Buna-N).
3. Miscellaneous metal items permanently installed within the wet well: Type 316 stainless steel. Type 304 stainless steel or galvanized steel is not acceptable.
4. Protective coatings: Discharge piping and other items within the wet well requiring protective coatings per Section 09960 shall be coated in accordance with the requirements for "submerged service."

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Equipment shall be installed in strict conformance with the manufacturer's installation instructions.

3.02 FIELD SERVICE

- A. The manufacturer of the pumps shall supply a competent field service engineer to thoroughly check and inspect the pumps after installation, place the pumps in operation and make necessary adjustments, and instruct County's personnel in proper operating and maintenance procedures before and after installation. Provide a minimum of 2 man-days of field service.

3.03 FIELD PAINTING

- A. Pumps and appurtenances shall be touched up as required, per Section 09960.

3.04 FIELD TESTING

- A. Each pump shall be field tested to verify that they are operating properly and are able to pump the design flow rate. Field testing shall be observed by the Construction Manager. For further requirements on performance tests, refer to Sections 11001 and 01660.

END OF SECTION

SECTION 11304

BIOLOGICAL ODOR CONTROL SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

- A. This section specifies requirements for a packaged 2-stage biological odor control system of unitary construction, including requirements for system construction, components, materials, functional testing, quality and use.
- B. The system shall consist of the following major components:
 1. Polypropylene exhaust fan
 2. FRP vessel with integral FRP inlet damper
 3. Inorganic biological media (Stage 1)
 4. Activated carbon Media (Stage 2)
 5. Media irrigation system and water cabinet
 6. FRP electrical control panel
 7. Nutrient tank
 8. Nutrient pump
 9. Exhaust stack

1.02 SYSTEM DESCRIPTION

- A. The biological odor control system shall consist of an exhaust fan, FRP vessel, inorganic biological media, activated carbon media, irrigation system, control panel, exhaust stack, dampers, valves, piping and all other equipment and accessories for a complete system.
- B. The complete odor control system shall be packaged and of unitary construction design. All components of the system shall be mounted on the vessel. No exception to this requirement is allowed.
- C. The packaged biological odor control system shall be a once-through system. The system is equipped with an exhaust fan that continuously draws the odor-laden air from the process areas into the biological odor control system for treatment. The biological odor control system shall be a two-stage system. Stage 1 shall utilize an inert, porous, mineral, expanded clay material designed to remove hydrogen sulfide (H₂S) and resist compaction and degradation from the acidic sulfates of the biological oxidation of the hydrogen sulfide. Stage 2 shall utilize a pelletized coal activated virgin carbon media to remove any remaining hydrogen sulfide as well as other odorous organic compounds.

- D. The first stage shall operate with an independently controlled irrigation process to provide Stage 1 media with adequate moisture and nutrients to sustain bacterial growth and to remove toxic byproducts. The irrigation process shall be controlled by a programmed timing sequence that actuates a solenoid valve located on the water supply piping. Nutrients shall trickle down over the media to enhance and sustain the biological activity. The nutrients shall be housed in a tank and shall be dosed into the system by a nutrient pump. A pre-wired control panel shall be provided to ensure proper control and operation of the system. The cleaned air is discharged to the atmosphere after passage through the fan located at the top of the vessel.
- E. The odor control system shall be designed for the following operating conditions:

Model Number	
Quantity	1
Airflow Rate, cfm	162
Average Inlet H ₂ S Conc., mg/L	1
Peak Inlet H ₂ S Conc., mg/L	31
Outlet Concentration 1-10 ppm H ₂ S >10 ppm H ₂ S	0.1 ppm H ₂ S 1% of inlet

- F. The pressure drop across the biological odor control system shall not exceed 4.25 inches at the maximum airflow rate specified above.

1.03 REFERENCE STANDARDS

- A. PS 15-69: National Bureau of Standards Voluntary Product Standard "Custom Contact Molded Reinforced Polyester Chemical Resistant Process Equipment."
- B. ASTM D-883: "Definition of Terms relating to Plastics."
- C. ASTM D-2583: "Test for Indentation Hardness of Rigid Plastics by Means of Barcol Impressor."
- D. ASTM D-2563: "Recommended Practice for Classifying Visual Defects in Glass Reinforced Plastic Laminate Parts."
- E. ASTM D-4097-82: "Standard Specifications for Contact Molded Glass Fiber Reinforced Thermoset Resin Chemical Resistant Tanks."

F. ASTM C 582: Standard Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment.

1.04 QUALITY ASSURANCE

A. MANUFACTURER REQUIREMENTS:

1. All equipment provided under this section shall be obtained from a single manufacturer, who shall:
 - a. Assume full responsibility for the completeness and proper operation of the biological odor control system.
 - b. Have experience in designing and manufacturing biological odor control system equipment. The odor control system manufacturer shall show evidence of at least ten (10) identical 2-stage design installations of the type specified in wastewater plants with specified non-proprietary expanded clay biofiltration media.
 - c. Supply units containing all necessary appurtenances and components for a complete and operating system conforming to this specification. The entire system shall be pre-assembled, piped, wired, and factory tested prior to shipment to facilitate installation and start-up at the jobsite.
 - d. Supply units with inorganic biological odor control expanded clay media. Systems using any proprietary media shall not be acceptable.
 - e. The complete biological odor control system, including vessel, fan, media, nutrient tank, nutrient pump, water irrigation cabinet, piping and accessories, and controls shall be of unitary construction.
2. To ensure quality and complete unit responsibility, the complete system must be assembled and tested by the manufacturer at its facility and be a standard and regularly marketed product of that manufacturer.
3. The OWNER reserves the right to be present at the manufacturer's facility for visual inspection of equipment to be supplied and to witness factory functional testing.

B. WARRANTY:

1. The manufacturer shall warrantee that the equipment provided shall be free of defects in material and workmanship for a period of 12 months from beneficial occupancy or for 18 months from delivery of the system to the jobsite, whichever is shorter in duration. The warranty does not apply to the carbon media.

1.05 SUBMITTALS

- A. The following product information shall be submitted by the biological odor control system manufacturer for review and approval prior to the fabrication of the system:

1. Shop drawings and catalog literature showing dimensional information, details of piping and fabrication and erection of all materials and equipment furnished under this section.
2. Drawing of general arrangement and major system components
3. Process and Instrumentation drawing
4. Major system component information and descriptive literature for the following:
 - a. Exhaust fan
 - b. Nutrient pump
 - c. Water irrigation cabinet
 - d. Vessel fabrication
 - e. System controls and control panel details including power and control wiring diagrams, terminals, and numbers
 - f. Miscellaneous instrumentation and accessories

1.06 OPERATION AND MAINTENANCE MANUAL

- A. Detailed operation and maintenance (O&M) manual for the system shall be provided by the manufacturer. A total of two (2) hardcopies and one (1) PDF copy of the O&M manual are required.

1.07 MANUFACTURER SERVICES

- A. The system manufacturer shall be present at the jobsite for the following time period after the system is installed, travel time excluded:
 1. Sixteen (16) hours for system startup, certification of proper installation and training of Owner's staff in operation of the system.
 2. Provide one trip for up to two (2) days for these tasks.

PART 2 - PRODUCTS

2.01 BIOLOGICAL ODOR CONTROL SYSTEM

- A. The odor control gas treatment system shall be a once-through biologically active odor removal system treating the odorous air from the contaminated process areas. The system shall be designed for continuous and automatic operation as well as manual operation as required.
- B. The biological odor control system shall be a two-stage system. The system shall consist of one biological treatment stage (Stage 1) followed by an activated carbon polishing stage (Stage 2) in series. The first stage shall be wetted with recycled water. The first stage shall include a spray header to distribute liquid evenly over the media.
- C. FRP vessel, inorganic biological media, activated carbon media, exhaust fan, exhaust stack, nutrient tank, nutrient pump, water irrigation system, air

- distribution system, control panel and all other required appurtenances shall be pre-assembled as complete 2-stage biological odor control system package.
- D. The biological odor control system shall include a fan located downstream from the system on top of the FRP vessel. The biological odor control system shall be designed to be operated under negative pressure.
 - E. The entire system shall be pre-assembled, piped, wired, and factory tested prior to shipment.
 - F. The biological odor control system shall be an I-Box system manufactured by Integrity Municipal Systems, LLC or an approved equal.

2.02 FRP VESSEL

- A. The FRP vessel shall be of unitary construction.
- B. The FRP vessel shall have all components pre-mounted and piped. The system vessel shall be shipped as one piece. The system shall be included with all piping, valves and internals. The system top shall be removable for access to the top of the vessel's second stage.
- C. The biological odor control system shall be manufactured with the following material of construction according to following fabrication method:
 1. Vessel and accessories shall be constructed by the contact molded, hand lay-up method, in accordance with ASTM C 582. The scrubber sidewalls may contain filament wound layers, but they shall also contain contact molded layers.
 2. Resin used in fabrication shall be a premium vinyl ester resin such as Hетron 922 or Derakane 411 by Ashland Chemical, Vipel F010 by AOC or approved equal. The resin shall be reinforced with an inner veil of suitable synthetic organic fiber such as Nexus 111-00010.
 3. Reinforcement: Glass fiber reinforcement used shall be commercial grade corrosion resistant borosilicate glass.
 4. Fabrication:
 - a. General: Fabrication shall be in accordance with NBS PS 15-69, ASTM D 3299, ASTM D 4097 and ASTM C 582. All non-molded surfaces shall be coated with resin incorporating paraffin to facilitate a full cure of the surface. All cut edges, bolt holes, secondary bonds shall be sealed with a resin coat prior to the final paraffinated resin coat.
 - b. Corrosion Liner: The inner surface of all laminates shall be resin rich and reinforced with one NEXUS 111-00010 with a minimum thickness of 10 mils. The interior corrosion layer shall consist of two

- layers of 1-1/2 oz. per sq. ft. chopped strand mat. The total corrosion liner thickness shall be a minimum of 100 mils.
- c. Structural Laminate: Structural laminates shall consist of alternating layers of 1-1/2 oz per sq. ft mat of chopped glass and 24 oz per sq. yard woven roving applied to reach a designed thickness. The exterior shall be surface coated with white gel coat containing ultraviolet light inhibitors.
- D. Access Manways: The vessel shall be provided with access manways to allow access to the internals of the odor control system. As a minimum, access manways shall be provided between stages.
- E. Media support and screen: The system vessel shall be provided with an FRP support system with polypropylene screen to accommodate the biological media and carbon media beds.
- F. Vessel Accessories: The system shall be provided with all piping, valves and internals. Air inlet, air outlet, spray headers, drain and all vessel fittings shown on the drawings shall be provided by the Manufacturer. An integral FRP damper shall be provided as a part of the vessel inlet.
- G. Hardware and Gaskets: All hardware and anchor lugs shall be 316 stainless-steel. All bolts shall be designed for the specified loads. Gaskets shall be a minimum of 1/8" thick, full face, EPDM.
- H. Neoprene Pad: A 1/4-inch thick, 60-durometer neoprene pad must be placed underneath the scrubber vessel during installation.

2.03 ODOR CONTROL MEDIA

- A. Stage 1 media shall be an inorganic expanded clay biological media as the support substrate for selectively growing sulfur-oxidizing autotrophic bacteria. The media shall be randomly dumped in the vessel to allow a low-pressure drop. The media is porous and is resistant to hydrogen sulfide (H_2S) and acidic conditions. The media shall be non-proprietary and commercially available.
- B. Stage 2 media shall be a coal based high H_2S capacity activated carbon media (0.3 g/cc capacity) to adsorb residual H_2S and other odor compounds. This stage shall provide final removal of odors to specified level. No exception to this requirement is acceptable.
- C. Overall media depth shall be a minimum of 51 inches.

2.04 EXHAUST FAN

- A. The fan shall be factory assembled complete with fan wheel, fan housing, bearings, drive, drive guard, motor, and unit base.

- B. Fan shall be direct drive, centrifugal type. Wheel shall be electronically and dynamically balanced.
- C. Fan shall be polypropylene of spark resistant design.
- D. Fan performance shall be based on tests conducted in accordance with AMCA 210-85 and ISO 5801.
- E. Fan base shall be galvanized steel with enamel coating. No metal parts shall be exposed to the corrosive airstream. All fasteners and hardware shall be 316 stainless-steel.
- F. The fan shall be designed for the following specifications:
 - 1. Airflow Rate, cfm 162
 - 2. S.P. up to System Inlet, in W.C. 2.00
 - 3. Total Pressure Drop, in W.C. 2.25
 - 4. Motor, HP 1.0

2.05 EXHAUST STACK

- A. The scrubber system shall be provided with an exhaust pipe manufactured of PVC.
- B. The exhaust pipe shall be connected to the fan outlet.

2.06 ELECTRICAL CONTROL PANEL

- A. The electrical control panel shall house all required controls for the entire system. The electrical control panel is pre-mounted on the system and pre-wired at the factory.
- B. The control panel enclosure shall be rated NEMA 4X and shall be made of FRP. The control panel shall be factory tested to full operation with all other components prior to shipment.
- C. The control panel shall provide electrical control for the entire system with as a minimum the following switches, alarms and accessories:
 - 1. "On-Off" switch for exhaust fan.
 - 2. "Exhaust Fan Running" indicator light.
 - 3. "Hand-Off-Auto" switch for nutrient pump.
 - 4. "Nutrient Pump Running" indicator light.
 - 5. Push button switch with status lights for water valve.
 - 6. Timer relay for on/off control of water valve.
 - 7. Control transformer (480V to 120V).
- D. The power supply shall be 480V, 3 ph, 60 Hz.

E. Control panel shall be provided with terminal strip as required for easy wiring connections by the contractor.

2.07 INSTRUMENTATION AND WATER CONTROLS

A. The water irrigation controls shall be mounted in a completely separate FRP water cabinet on the vessel and shall consist of the following components:

1. Ball valves.
2. Pressure reducing valve.
3. Pressure gauge.
4. Solenoid valve.
5. Gate control valve.
6. Rotameter: Variable area type with a Teflon float, EPR O-rings and PVC fittings. The rotameter shall have a direct reading scale.
7. Nutrient injection connection.
8. Nutrient pump.

B. An independent media irrigation system is incorporated into Stage 1 to provide the biological media with adequate moisture. The system shall be designed to irrigate the top of the first media bed with complete and even coverage via spray nozzles. Water used for this purpose must have residual chlorine concentrations less than 5 ppm.

2.08 PIPING

A. All make-up water and drain piping shall be SCH 80 PVC.

2.09 INTEGRATED NUTRIENT RESERVOIR AND NUTRIENT PUMP

A. Nutrient addition: The packaged biological odor control system uses a non-proprietary, commercially available fertilizer to provide essential nutrients to optimize the growth of sulfur-oxidizing bacteria. Nutrients supplied as a coating to the support media or proprietary nutrients shall not be allowed. The system shall be equipped with a nutrient addition system that provides a controlled dosage of nutrients that is automatically fed to the irrigation water during each irrigation cycle with the help of a nutrient pump.

B. The nutrient reservoir shall be integral to the system and mounted on the side of the vessel. The nutrient reservoir shall be made of FRP.

C. The nutrient pump shall be solenoid type and shall be mounted in the water cabinet.

2.10 SPARE PARTS

A. Provide one (1) spare exhaust fan and one (1) spare nutrient pump to the Owner.

PART 3 - EXECUTION

3.01 FACTORY ASSEMBLY AND TESTING

- A. Each system shall be pre-assembled at the manufacturing location.
- B. System shall be tested at the location of assembly to assure they are in full operational and working order per the requirements of the specific design for the project as described in this specification.
- C. Owner reserves the right to be present at the manufacturer's testing facility to witness the factory functional testing. Owner shall provide intent to witness functional testing at the time of the design submittal review and approval, and manufacturer shall provide notice to Owner regarding the scheduled time of the functional testing at least five business days in advance of the proposed functional testing.
- D. Factory testing shall include visual inspection of all equipment, complete assembly and functional operating testing of components including piping and equipment check, and verification of control panel wiring and operation.

3.02 DELIVERY AND INSTALLATION

- A. System shall be packaged and shipped so as not to incur damage to any portion of the system through handling and installation of the system itself.
- B. System shall be installed per the manufacturer's guidelines and recommendations. Installation shall include the re-assembly of any items separately packaged for protection during shipment. Site preparation, utility service and installation are not provided by the manufacturer under these specifications.
- C. Contractor shall provide:
 1. FRP inlet piping from pick-up point source to vessel inlet connection.
 2. Wiring to/from system control panel to remote-mounted equipment, plant SCADA, etc.
 3. Power to system control panel (480V, 3-phase, 60 Hz, 25 Amps)
 4. Suitable concrete mounting pads and other incidentals as necessary to complete the installation.
 5. Drain a 1-inch PVC gravity drain to sewer with a barometric trap.
 6. Water Supply: A $\frac{3}{4}$ -inch recycled water supply with backflow preventer is required. The nominal water requirements are at a rate of 6.0 gpm and a pressure of 30 psi. Hardness shall not exceed 200 mg/l as calcium carbonate.

3.03 FIELD START-UP

- A. The odor control system shall be field tested to verify that it is operating properly and able to meet the specified outlet concentrations. Field testing shall be observed by the Construction Manager. For further requirements on performance tests, refer to Sections 11001 and 01660.

END OF SECTION

SECTION 13214

ABOVEGROUND FUEL STORAGE TANKS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Furnishing and installing complete, tested, and operable double-wall outdoor diesel fuel storage tank, indoor diesel fuel day tank, diesel fuel transfer pumps, tank accessories and controls as shown on the Drawings and as specified herein.

1.02 REFERENCES

A. UNDERWRITER LABORATORIES INC. (UL):

1. 142 Standard Specification for Steel Tank Construction
2. 1709 Rapid Rise Fire Tests of Protection Materials for Structural Steel
3. 2085 Standard for Protected Aboveground Tanks for Flammable and Combustible Liquids

B. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA):

1. 1 Fire Code
2. 30 Flammable and Combustible Liquids Code

C. INTERNATIONAL BUILDING CODE (IBC)

1.03 SUBMITTALS

A. Shop Drawings and Product Data: Submit the following as a single complete initial submittal in accordance with Section 01300:

1. Product data fully describing all items proposed for use to demonstrate that the equipment conforms to the Specifications.
2. Seismic anchorage certification and related sketch in accordance with Section 01190.
3. Certification of UL listings, IFC and NFPA standards, and compliance with specified performance.
4. Drawings showing the layout and accessory locations.
5. Submit layout drawings and schematics and design calculations to demonstrate that pipe support systems that are not as shown on the Drawings are in accordance with the design criteria. The proposed piping support system shall be submitted for approval prior to the pouring of the concrete structure.

- B. **Manuals:** Furnish manufacturer's installation and operation and maintenance instructions.
- C. **Affidavits:** Submit affidavits from the manufacturer stating that the equipment has been properly installed and tested and is ready for full-time operation.

1.04 QUALITY ASSURANCE

- A. **Qualifications:** Equipment furnished under this Section shall be supplied by a manufacturer who has been regularly engaged in the design and manufacture of the equipment for at least 5 years. Demonstrate to the satisfaction of the Engineer that the quality is equivalent to equipment made by those manufacturers named herein.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Use non-marring slings for loading, unloading and handling units to prevent rope or cable damage to surfaces and protective wrappings.

1.06 WARRANTY

- A. The aboveground fuel storage tank shall be warranted by the manufacturer for a period of 20 years from the date it is put in service. The warranty shall cover tank replacement in the event of a tank failure occurring under normal working conditions.

PART 2 - PRODUCTS

2.01 OUTDOOR DIESEL FUEL STORAGE TANK

- A. Furnish and install an aboveground, double wall, insulated, fuel storage tank with steel primary and secondary containment as specified herein and as shown on the Drawings. Tanks shall be UL 2085 listed Convault doublewall 3000 (CVT-3000DW) as provided by Convault; or equal.
- B. Rectangular Tank Capacity and Dimensions:
 1. Nominal Capacity: 3,000 gallons
 2. Maximum Dimensions:
 - a. Length: 35 inches
 - b. Width: 96 inches
 - c. Height: 87 inches
- C. Construct fuel tank in conformance with UL 2085, NFPA 1 and NFPA 30. Tank shall be UL listed as both a "protected" and "fire-resistant" above ground storage tank. Tank shall maintain both primary and secondary tank integrity after UL 1709 2-hour fire exposure.

- D. Provide tank complete with threaded connections as shown on the Drawings.
- E. Seismically restrain and anchor fuel tank in accordance with the IBC. Refer to Division 1 for seismic design requirements.
- F. Supply sufficient diesel fuel for testing of the fuel system operation. The Contractor shall fill the aboveground fuel tank at the completion of the project.
- G. Accessories: The following are minimum requirements for tank accessories. Provide additional accessories as required to comply with applicable codes, or as recommended by the tank supplier.
 - 1. Fill Inlet: Fill inlet tank connection shall include a spill containment pan, cam lock fill adapter, overfill prevention valve, drop tube, and lockable fill cap.
 - a. Containment pan shall have a minimum 5-gallon capacity and shall have drain tube that drains any spillage back into the tank. Cover shall have a lockable hasp. Morrison Series 518 or equal.
 - b. Overfill prevention valve shall automatically stop fuel flow and 95% capacity and drain fuel from the highest point to allow fill nozzle to be removed without spilling. Morrison Series 9095A or equal.
 - c. Drop tube shall be installed on fill connection and shall terminate within 6 inches of the bottom of the tank. Morrison Series 419 or equal.
 - 2. Aboveground Flex Connector:
 - a. Stainless steel outer braiding and inner pipe.
 - b. UL-approved and meets IFC requirements for aboveground fuel tanks.
 - c. Manufacturer: Hose Master or equal.
 - 3. Emergency Vents: Provide UL listed emergency vents for the primary and secondary spaces. Emergency vent shall be Morrison Bros. 2440OM or equal.
 - 4. Primary Vent: The primary vent for the tank shall installed as shown on the Drawings. The vent body shall be constructed of aluminum. The vent shall be provided with a 40 mesh, brass, flame arrestor screen. The vent cap shall be removable with a grooved drain lip for water drain-off. Vent shall be Pomeco OPW 515ML Series; or equal.
 - 5. Liquid Level Gage:
 - a. An easy to read, mechanically operated gage, marked at 90% of tank capacity and observable during tank filling.
 - b. Manufacturer: Type H-2 Therma-Gauge by Krueger or approved equal.
 - c. Tank Level Gauge Rods: Hardwood gauging rods calibrated for the tank.
 - 6. Stairs: Provide aluminum bolt-on stairs to access the top of the tank for normal servicing. Provide guardrails or other accessories required by code for the installation shown on the Drawings.

7. Additional requirements for piping, valves and accessories are included in Section 15050.

2.02 TANK MANAGEMENT SYSTEM

- A. Tank Management System: Provide a tank management system to continuously monitor any leak from the diesel storage tank, and to sense level and water content conditions in the diesel storage tank. The system shall have the capacity to continuously monitor the number of in-tank level probes and secondary leak, water content, or point level sensors as shown on the Drawings. Materials of all components shall be as recommended by the manufacturer for diesel fuel service. Cable, visual alarms, remote test and self-diagnostic trouble alarm, intrinsic safety barrier, auxiliary relays, and all required accessories and adapters shall be provided for installation as shown on the Drawings. The system shall be fully automatic and shall include, but not be limited to the following.
1. Tank Leak and Level Detection Panel (LCP-001): Control panel shall be micro-processor based and designed and constructed with modular architecture to permit factory and field upgrades. Panel shall include audible and visual alarms and shall include a digital display for viewing tank information and LED indicators for alarm conditions. Panel shall be provided in a lockable NEMA 12 enclosure. Electrical service shall be 120-volt, 60 Hz. Pneumercator Model TMS 3000 level and leak management system; equivalent system by Veeder Root; or equal. Panel shall include the following.
 - a. Modbus RTU interface card.
 - b. Modbus RTU Ethernet combo card, Pneumercator Model 900665-5-3; or approved substitute.
 - c. Multi-Protocol Gateway, Pneumercator Model 900736-2; or approved substitute. Gateway shall, at a minimum, communicate Modbus TCP/IP protocol.
 - d. RS-485 ports for communication with one (1) remote alarm panel and one (1) spare.
 - e. The onboard internal Ethernet card shall communicate Pneumercator proprietary protocols as well as remote programming using Pneumercator's TMSComm Software.
 - f. Discrete and analog inputs/outputs as shown on the Drawings.
 2. Remote Alarm Panel (LCP-001A): Provide microprocessor based, addressable remote audible/visual alarm annunciators serving the storage tank consisting of a solid-state electronic strobe/siren combination housed in a NEMA 4X enclosure. Audible annunciator shall have a minimum rating of 100 dB at 10 feet. Visual alarm shall be a white LED strobe, visible from up to 300 feet. Panels shall include test and reset buttons for verifying both the audible and visual alarms. Acknowledging the alarms shall only silence the audible alarm, while the visual alarm remains until the condition is corrected. Units shall include

- RS-485 port for communication with the Tank Leak and Level Detection Panel (LCP-001). Electrical service shall be 120-volt, 60 Hz. Pneumercator Model RA-400-1; or equal.
3. Magnetostrictive Tank Gauging Probes (LE-001): Provide level probes designed for installation in an above-ground storage tank. Probes shall include an array of at least five (5) temperature sensors along its length for accurate volumetric temperature compensation. Probes shall be supplied with product float, water float, 6-foot leader cable with watertight connector, and centering rings for riser mounted applications. Probes shall be UL/CSA approved for installation in a Class 1, Division 1, Group C&D hazardous location. Pneumercator Model MP-450S tank gauging probe, or approved equal.
 4. Tank Leak Sensor (LE-001A): Provide electronic sensors utilizing optic technology and no moving parts to sense presence of liquid within the tank secondary containment space. Sensors shall include wiring and sensor fault detection. Pneumercator Model ES-825-100-F non-discriminating liquid sensor, or equal.

2.03 INDOOR DIESEL FUEL DAY TANK (T-002)

- A. Furnish and install an UL 142 listed aboveground fuel day tank with rupture basin, transfer pump, overflow return pump, tank level and pump controller, and accessories as specified herein and as shown on the Drawings. Tank shall be provided by Tramont; Earthsafe Systems; or equal.
- B. Fuel Day Tank Assembly: The fuel system shall consist of a fuel tank, double-wall (rupture basin) and shall include the following:
 1. 100-gallon capacity tank, UL 142 listed double-walled corrosion resistant steel, mounted as shown on the Drawings.
 2. Flexible connections shall be provided at all piping connections to the day tank. Flexible connections shall be in accordance with Paragraph 2.01.G.
 3. Primary normal and emergency vents and secondary emergency vents sized and installed in accordance with the Fire and Building Codes. Vents shall be in accordance with Paragraph 2.01.G.
 4. Liquid level gauge in accordance with Paragraph 2.01.G.
 5. Drain pet cock valve
 6. Fuel strainer
 7. Fuel leak and level control indicated in Paragraph 2.03.D.
 8. Other requirements for piping, valves, and accessories are included in Section 15050.
- C. Fuel Day Tank Pump Set: The fuel day tank shall be equipped with a duplex pump set with transfer pump and overflow return pump.

1. Transfer Pump: The transfer pump will transfer fuel from the aboveground storage tank to the indoor day tank. The pump shall be rated for 4 gpm at 80 psi TDH, 1/3 hp.
 2. Overflow Return Pump: The overflow return pump will transfer fuel from the indoor fuel tank to the aboveground storage. The pump shall be rated for 4 gpm (minimum) at 80 psi TDH, 1/3 hp.
 3. Pumps shall be provided with a single 120-volt, single phase, 60-Hz power supply. Pumps shall be UL listed positive displacement gear type.
 4. Pumps shall be pre-wired and include shutoff valves, factory-mounted disconnect switch, Manual-Auto-Off selector switch, power available indication, and integral pump motor starter with adjustable overload protection.
 5. Pump controller shall be UL listed and provide automatic control based on liquid level in the fuel day tank. The controller shall be able to detect dry run, under voltage, locked rotor, open circuit or lock rotor with thermal overload, uncalibrated, extended run, and relay fault. The controlled shall be equipped with a manual reset button.
- D. Fuel System Control: Provide leak and level detection system to monitor any leak from the day tank and to sense level conditions in the tank. The system shall be fully automatic and shall include, but not be limited to, level transmitter, leak sensor, cable, visual alarms, remote test and self-diagnostic trouble alarm, intrinsic safety barrier, auxiliary relay output for input to the Generator Control System, and false alarm suppression. Control panel shall be provided with a single 120 Volt, single phase, 60 Hz power supply. Power for the ancillary equipment included as part of the package shall be supplied from the control panel. See the Drawings for additional requirements and auxiliary contacts.
- E. Solenoid Valves: Install a solenoid valve on the supply line from the outdoor diesel storage tank to the indoor diesel fuel day tank. Wire solenoid valve on the supply line to the indoor diesel fuel day tank to the day tank control panel. With the selector switch in the 'Auto' mode, the valve shall 'open' and be energized when the engine is starting and operating. The valve shall 'close' and be de-energized, when the engine is off. With the selector switch in the 'Manual' or 'Hand' position, the valve shall be energized. With the selector switch in the 'Off' position, the valve shall be de-energized. Solenoid valves: 1-inch valve, UL approved and suitable for fuel applications.
- F. Seismically restrain and anchor fuel tank in accordance with the IBC. Refer to Division 1 for seismic design requirements.

2.04 PIPING, VALVES, AND ACCESSORIES

- A. Pipe, valve and accessories shall be as specified in Section 15050.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Tanks: Install in strict conformance to manufacturer's installation instructions.
- B. Fuel Piping: Install new piping from the aboveground diesel fuel tank to the diesel fuel day tank, and from the day tank to the diesel engine-generator in accordance with Section 15050 and as shown on the Drawings.
- C. Normal and Emergency Vent Piping: Install piping for the normal and emergency vents to meet the requirements of the Fire Code. All vent piping shall be terminated no less than 12 feet above ground level and 5 feet from any building opening.

3.02 FIELD QUALITY CONTROL

A. TESTING FOR LEAKS:

1. Disconnect fuel and vent piping from tank, seal ends and pneumatically test at 100 psig for not less than 1-hour.
2. Retest piping, if corrections are required, until the 1-hour test is successfully passed.
3. Initial air pressure may be corrected for temperature effects when evaluating the test results at the end of the 1-hour test period, should there be a change in air temperature during the test period.

3.03 FIELD PAINTING

- A. Damage to protective coating of fuel tank shall be repaired to the satisfaction of the Engineer with a System 1 coating as specified in Section 09960, at no additional cost to the Owner.

3.04 FIELD TESTING

- A. Field test all equipment operation in all modes of operation. Complete testing of the fuel system before starting testing of the standby generator.
- B. Fuel tank and all alarms shall be tested with diesel.
- C. Day tank refill shall be checked using diesel.

END OF SECTION

SECTION 14635

GANTRY CRANE AND TROLLEY HOISTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Furnish and install complete manual gantry crane, hoist and trolley system as shown on the attached Schedules, of the type indicated:
 - 1. Manual gantry crane
 - 2. Manual trolley
 - 3. Electric operated hoist

1.02 REFERENCES

- A. Hawaii Occupational Safety and Health Division (HIOSH).
- B. National Electrical Manufacturers Association (NEMA).
- C. Hoist Manufacturers Institute (HMI).
- D. American National Standards Institute (ANSI).
- E. Crane Manufacturers Association of America, Inc. (CMMA).

1.03 SUBMITTALS

- A. Submit in accordance with Section 01300 for Product Review.
- B. Shop Drawings: Submit shop drawings for favorable review of the hoist systems. Include sufficient data to show that equipment conforms to Specification requirements.
- C. Manuals: Furnish manufacturer's installation, lubrication, operation and maintenance manuals, bulletins, and spare parts list.

1.04 QUALITY ASSURANCE

- A. All equipment furnished under this section shall: (1) be of a manufacturer who has been regularly engaged in the design and manufacture of the equipment; and (2) be demonstrated to the satisfaction of the Engineer that the quality is equal to equipment made by those manufacturers specifically named herein.
- B. After manufacture, perform a certified shop load test on these units. Conduct the shop test of the assembled trolley and hoist with a minimum load of 125% of the rated load capacity.
- C. The trolley shall fit the beam supplied with the gantry crane and provide smooth travel without binding for the entire length of the trolley beam.
- D. All hoist systems specified in this section shall be furnished by one supplier.

PART 2 - EQUIPMENT

2.01 MANUFACTURERS

- A. Gantry Crane: Spanco, A-Series Aluminum; Gorbel; or approved equal
- B. Manual Trolley: Acco Wright; Yale; or approved equal
- C. Electric Hoist: Acco Wright; Yale; P&H; or approved equal

2.02 GANTRY CRANE

- A. Provide gantry crane constructed of aluminum with adjustable height, adjustable span, and the following features:
 1. Minimum clear span shall be 16'-9".
 2. Minimum clear height under the beam shall be 9'-10".
 3. Minimum rated capacity shall be 1-ton.

2.03 MANUAL TROLLEY

- A. Provide a manual trolley suited to the gantry beam with adequate capacity for the electric operated host.

2.04 ELECTRIC OPERATED HOIST

- A. Hoist Lift Height: The distance from the lowest floor elevation served by the hoist, to the maximum lifting elevation of the hoist hook shall be 30'.
- B. Wire Rope: Standard wire rope properly sized for the hoist's rated capacity.
- C. Positively anchor end of wire rope to hoist drum so that hoist can carry rated capacity when wire rope is completely unwound.
- D. Motors: NEMA Class F insulation and 30-minute duty rating, suitable for variable frequency drive.
- E. Gearing: Compact and enclosed in an oil-tight housing, and made of machine cut, heat treated alloy steel with shock resistant ductile cores.
- F. Lifting Hook: Heat treated, drop forged steel with a 360-degree swivel and safety spring latch. Guard all nip points at the lower hook position.
- G. Provide hoist with single speed control. Provide hoist with a motor brake that shall stop the hoisting motor when the power to the motor is off. Provide an independent automatic load brake capable of holding the hoist's rated capacity independently of the motor brake to assure that the load does not accelerate while being lowered. Provide an upper and lower screw type hook travel limit switch, equipped with an automatic momentary lowering circuit, in addition to the standard limit switches. Incorporate an overload cut-off device, either mechanical or electrical, in the hoisting mechanism to assure that no more than the hoist's rated capacity can be lifted by the hoist. Provide all additional devices required by HIOSH. Provide end stops on beam to fit trolley furnished.

- H. Electrical: The hoist shall use 115-volt, 1-phase, 60-Hertz electrical service, and have gasketed NEMA 1 control box and 115-volt controls. Protect motors and control power transformer with suitable fusing devices using National Electrical Code requirements as a minimum. Provide hoist limit switch to cut-out power at the full raised position.
- I. Electrification: Provide electrification system designed for electric hoist. Festooned tagline shall support power supply cable and control wiring for hoist and trolley.
- J. Paint: Provide corrosion-resistant coating in manufacturer's standard colors.
- K. Controls: Provide a cord and pushbutton gas-tight NEMA pendant with adequate cord. Locate control pendant approximately 4 feet above the finished floor line. Attach pendant to an electric cable that is suspended from an offset arm so that the operator may walk alongside the load while it is being moved. Protect motors and control power transformer with suitable fusing devices using National Electrical Code requirements as a minimum.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. The CONTRACTOR shall assemble the gantry crane and install the trolley and hoist on the gantry crane beam in accordance with the manufacturer's instructions.

3.02 TESTING

- A. After field installation, adjust stop and limit switches and test the assembled unit over its full range of travel. Perform all tests to comply with HIOSH requirements and furnish certificates of compliance.

END OF SECTION

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SECTION 15050
PIPING, VALVES, AND ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

- A. **Section Includes:** Provide all piping, including fittings, valves, supports, and accessories as shown on the Drawings, described in the Specifications and as required to completely interconnect all equipment with piping for complete and operable systems, including equipment drains.

1.02 REFERENCES

- A. Air-Conditioning and Refrigeration Institute (ARI)
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
- C. ASTM International (ASTM)
- D. American Society of Mechanical Engineers (ASME)
- E. American National Standards Institute (ANSI)
- F. American Water Works Association (AWWA)
- G. American Welding Society (AWS)
- H. Cast Iron Soil Pipe Institute (CISPI)
- I. U.S. Department of Transportation (DOT)
- J. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS)
- K. National Fire Protection Association (NFPA)

1.03 SUBMITTALS

A. **SHOP DRAWINGS:**

1. Verify by excavation, inspection and measurement all installation conditions, including existing utilities and structures, for all pipe before preparation of Shop Drawings. Submit field measurements and photos with Shop Drawings where exposed conditions are significantly different than indicated on the Drawings.

2. Layouts and Schematics: Submit detailed installation drawings of all piping. Schematics may be submitted for piping 4 inches and smaller. The Drawings and schematics shall include pipe support locations and types, fittings, valves, other appurtenances. (Product Review)
 3. Submit data to show that the following items conform to the Specification requirements:
 - a. Pipe, fittings and accessories (Product Review).
 - b. Pipe couplings and flexible pipe pieces (Product Review).
 - c. Valves and Accessories (Product Review).
 4. Submit samples of gaskets and other materials where required by the detailed specifications.
 5. Submit certified test reports as required herein and by the referenced standard specifications (Product Information).
 6. Samples: Solder and flux for copper pipe.
 7. Testing data for welded joints. Welds.
 8. Submit leak and pressure testing plan in accordance with the requirements in 3.09.
 9. Submit shop drawings for leak and pressure testing apparatus including, but not limited to, temporary bulkheads necessary for testing of new pipelines.
- B. Manuals: Furnish manufacturer's installation and operation manuals, bulletins, and spare parts lists for the following items:
1. Valves 4 inches and larger.
- C. Field test reports as required in Part 3.

1.04 QUALITY ASSURANCE

- A. Materials and equipment furnished under this Section shall be of manufacturers who have been regularly engaged in the design and manufacture of the materials and equipment for a period of at least 5 years. Demonstrate to the satisfaction of the Engineer that the quality is equal to the materials and equipment made by the manufacturers specifically named herein, if an alternate manufacturer is proposed.
- B. Factory Quality Control: The Contractor shall test all products as noted herein and by the reference specifications.
- C. Field Quality Control:
 1. The Construction Manager will:
 - a. Inspect field welds and test the welds if it is deemed necessary.
 - b. Perform bacteriological analysis for pipelines to be disinfected.
 2. The Contractor shall:
 - a. Perform leakage tests.

- b. Be responsible for the costs of additional inspection and retesting by the Construction Manager resulting from noncompliance.

1.05 PIPING SYSTEMS

- A. The various piping systems are identified by a multi-letter code on the Drawings. Unless otherwise shown on the Drawings, each system shall be constructed using the materials indicated for that system in the Pipe Schedule. Piping materials are identified by type designation in the schedule unless otherwise noted, and most valves and accessories are identified by a valve and accessory system unless otherwise noted.

1.06 APPURTENANCES

- A. Furnish and install all necessary guides, inserts, anchors and assembly bolts, washers and nuts, hangers, supports, gaskets, couplings, and flanges; all other appurtenant items shown on the Drawings, specified or required for the proper installation and operation of the piping; devices included in or on the piping equipment; and piping accessories.

1.07 PIPE SUPPORTS

A. GENERAL:

- 1. Piping 6 Inches and Larger: Pipe supports are shown on the Drawings for piping 6 inches and larger in diameter, where the piping is shown on layout drawings. Each pipe support used is designed to resist seismic loading except where the support is of the sliding type for thermal expansion. Other supports are provided to resist axial seismic loading of pipes designed for thermal expansion. Pipe supports that are considered seismic resistant are so noted on the pipe support detail sheets on the Drawings. The location and types of supports and braces are indicative and may be modified by the Contractor to suit field conditions, provided the modified support system conforms to the design criteria stated herein, and receives the favorable review of the Engineer. Where piping is shown schematically only, it shall be the Contractor's responsibility to support all such piping in accordance with the design criteria stated herein and using support details shown on the Drawings. Pipe supports have been designed assuming flanged joints on ductile iron pipe and steel pipe, unless otherwise indicated on the Drawings. If groove type mechanical couplings are used as an alternative, provide additional supports where required, particularly to resist rotation. Shop drawings of these additional supports shall be favorably reviewed by the Engineer prior to installation.
- 2. Piping Less Than 6 Inches: Pipe supports are generally not shown for piping less than 6 inches in diameter. Where supports are not shown, it shall be the Contractor's responsibility to support all such piping in

- accordance with the design criteria stated hereinafter and the support details shown on the Drawings. Piping 2-1/2 inches and larger and all piping for hazardous chemicals shall be supported with pipe supports designed to resist seismic loads. Hazardous chemical piping includes fuel piping. Piping smaller than 2-1/2 inches with non-hazardous contents may be supported with non-seismic resistant supports.
3. Where not detailed or otherwise indicated, pipe support types and spacing shall be in accordance with the Manufacturer's Standardization Society (MSS) Standard Practice No. SP-58 and No. SP-69, except as superseded by the requirements of these Specifications. Hangers and supports used as components of a fire protection system shall comply with NFPA Standard No. 13 and be listed and labeled by UL and FM.

B. PIPE SUPPORT SYSTEM DESIGN:

1. Design Loads: Pipe suspension shall be such as to prevent excessive stress or excessive variation in supporting force while system is in operation. Pipe supports shall support the sum of the weight of the pipe, fittings, appurtenances, and contents. In addition, the pipe shall be anchored to resist internal pressure forces tending to separate any unrestrained joint at pressures 1-1/2 times the maximum working pressure for the applicable service.
2. Seismic Loads: Seismic loads, expressed as a percentage of the weight of the contributing length of pipe, fittings, appurtenances, and contents, are 45% in any direction within the horizontal plane of the pipe, and 23% up or down within the vertical plane of the pipe.
3. Location: All piping shall be supported in a manner that will prevent undue strain on any valve, fitting, or piece of equipment. In addition, pipe supports shall be provided at changes in direction or elevation, adjacent to flexible couplings, at all nonrigid joints, at hose bibbs, and where otherwise shown. Where piping connects to equipment, it shall be supported by a pipe support and not by the equipment.
 - a. Maximum support spacing shall conform to the following table:

Pipe Size Inches	Pipe Material	Maximum Spacing Feet
1-inch and smaller	Iron or Steel Copper Plastic Tubing	6 4-1/2 continuous continuous
1-1/4 to 2 inches	Iron or Steel Copper or Plastic	8 5
2-1/2 to 4 inches	Iron or Steel Copper or Plastic	10 6
6 to 8 inches	Iron or Steel Plastic	12 8
10 inches and larger	Iron or Steel	15

- b. Piping penetrations through concrete walls and slabs are considered to resist seismic loading, provided penetrations for pipes 3 inches in diameter and larger are complete with a wall flange.
 - c. Branch piping is not considered to provide resistance to seismic forces.
4. Anchors: Anchors for connecting pipe supports to concrete shall be in

PART 2 - PRODUCTS

2.01 GENERAL

- A. Pipe and valve sizes are nominal inside diameter unless otherwise noted.
- B. Construct vents of materials specified for the pipe system for which they serve.
- C. All materials delivered to the job site shall be new, free from defects, and marked to identify the material, class, and other appropriate data such as thickness for piping.
- D. Acceptance of materials shall be subject to strength and quality testing in addition to inspection of the completed product. Acceptance of installed piping systems shall be based on inspection and leakage tests as specified hereinafter.
- E. Cutoff Flanges: Provide at all pipe or sleeve penetrations where cast into wall for pipes 4 inches and greater in nominal diameter, and at all penetrations of 3-inch and smaller nominal diameter pipe in wet or potentially wet locations as indicated on the Drawings. Cutoff flange outside diameter shall be at least a standard connection flanges outside diameter except that for pipe 30-inch-diameter and larger, nominal size, cutoff flange outside diameter may be

6 inches greater than outside pipe diameter. Cutoff flange shall be at least $\frac{1}{4}$ -inch thick and shall be continuously welded (or cast) onto the pipe.

2.02 GENERAL MATERIAL REQUIREMENTS

- A. Gaskets: Except where specified otherwise, gaskets shall be NBR rubber.
- B. Bolts and Tie Rods: Unless specified otherwise herein, flange bolts and nuts, coupling bolts and nuts, tie rods, and other hardware shall be as follows:
 1. Exposed: Electroplated zinc or cadmium steel.
 2. Submerged: Type 316 stainless steel, minimum tensile strength: 60,000 psi.
 3. Concrete Encased: Steel.
 4. Buried: Type 316 stainless steel, minimum tensile strength: 60,000 psi.
 5. Apply an anti-galling compound to the threads of stainless steel bolts.
- C. Flexible Sealant: Flexible sealant for pipe joints, where shown on the Drawings, shall be a two-component polysulfide, non-sag; Sikaflex 2C, Daulthane, or approved equal.
- D. Fusion Epoxy Coating: AWWA C213; except application shall be by fluid bed only unless the greatest dimension of the article to be coated exceeds 10 feet, in which case electrostatic spray or flocking application may be used.
- E. All materials in contact with potable water shall comply with the Safe Drinking Water Act and NSF requirements for use in water systems.

2.03 PIPING MATERIALS

- A. Pipe and Fitting Designation: Piping materials are identified by a "Type" designation in these Specifications. The "Type" designation identifies not only the pipe itself, but the associated fittings and appurtenances and the installation and test procedures described for that "Type." The designation of a particular type shall indicate a complete installation including fittings, joints, cleaning and testing. The pipe and fitting materials for each type of designation shall be as specified herein and summarized in the Pipe Type Schedule.
- B. Pipe Schedule: Piping systems and their corresponding piping and valve systems are listed on the Drawings.
- C. Pipe Type Schedule: Pipe material, joints, and fittings shall be as summarized below. A detailed specification of each pipe type follows. (The detailed specification supersedes the schedule in case of any conflicts.)

Pipe Type	Pipe Description	Field Joints	Fittings
CUP	Copper	Solder or Flare	Wrought Copper or Bronze
BS	Black Steel, Schedule 40	Weld	Steel
CURT	Copper Refrigerant Tube	Brazed	Wrought Copper
DIPF	Ductile Iron Flanged Pipe	Flange or Mech. Groove Coupling	DI
PVC-1	PVC, Schedule 80	Threaded or Solvent Weld	PVC, Schedule 80
PVC-4	PVC; Pressure Rated	PVC, Pressure	B&S
PVC-5	PVC; Sewer	PVC, Sewer	B&S
PVC-6	PVC, Drain, Waste and Vent	B&S	PVC
SSP	Stainless Steel Pipe	Flanged or Weld	Stainless Steel

D. CUP PIPE:

1. Pipe: Copper, ASTM B88.
 - a. Buried: Type K (soft drawn).
 - b. Exposed: Type L (hard drawn).
2. Joints:
 - a. Buried: Soldered or flared.
 - b. Exposed: Soldered.
3. Solder: ASTM B32, Alloy Grade SN 94, SN 95 or SN 96. Solder and flux shall contain less than 0.2% lead.
4. Fittings:
 - a. Soldered: Wrought copper, ASTM B75 for materials and ANSI B16.22 for dimensions; or cast bronze, ASTM B62 for materials and ANSI B16.18 for dimensions.
 - b. Flared: AWWA C800 and ANSI B16.26.

E. BLACK STEEL (BS):

1. Pipe: Schedule 40 black steel, ASTM A53, Grade B, butt weld or seamless.
2. Joints: Butt welded or socket welded, except where otherwise shown on the Drawings and where screwed or flanged accessories or valves are required.
3. Fittings: Forged steel, butt weld type, same Schedule as pipe conforming to ASTM A234, or 2,000 psi forged steel socket weld fittings conforming to ASTM A105.

4. Flanges: Where required to connect to flanged equipment or valves, shall be slip-on or weld-neck type conforming to ASTM A105 or ASTM A181. Flange drilling and facing shall match that of the flanged valves or equipment to which the pipe connects.
5. Branches two sizes or smaller than pipe main may be made with factory fabricated steel welding saddles manufactured by Bonney; Ladish; or equal.
6. Provide factory fabricated double containment piping for all buried diesel fuel piping. Carrier piping shall meet the above specifications. Containment piping shall UL FRP. Interstitial supporting devices used to center and support primary piping and fittings shall meet ASTM D 2310, D 2292, D 2296 and MIL 29206. Containment fittings shall have carrier components pre-assembled, supported and tested. Containment fittings shall have spigot ends to allow for closure coupling installation after testing of primary system. Manufacturer: IPEX CustomGuard or equal.
 - a. Provide underground leak detection stations with sensors and pump out ports as shown on the Drawings. Leak sensors shall be wired to the Fuel Leak and Level Detection System Control Panel specified in Section 13214.
 - b. Provide factory fabricated double contained flexible connection where differential settlement may occur and elsewhere as indicated on the Drawings. Containment piping shall be 3-inch Type 316 stainless steel flexible hose. Carrier pipe shall be ½-inch Type 316 stainless steel flexible hose. Flexible connection shall be minimum 18 inches in length and shall not compromise the integrity of the double-containment piping. IPEX ½-inch x 2-inch flexible connection with FRP PUPS or equal.
 - c. See the Drawings for additional requirements.

F. CURT PIPE:

1. Pipe: Copper, ASTM B-280:
 - a. Buried: Type ACR, Type K annealed tempered copper tubing.
 - b. Exposed: Tube Type ACR, soft annealed, bright seamless, ASTM B280
2. Joints:
 - a. Buried: No joints; provide continuous length of pipe for any buried segments.
 - b. Exposed: Brazed.
3. Fittings:
 - a. Soldered: Seamless wrought copper, ASME B16.22.

G. DIPF PIPE:

1. Pipe: Flanged or grooved end ductile iron.
 - a. Flanged Pipe: AWWA C115 including Appendix A, minimum thickness Class 53.

2. Flanges: Ductile iron, plain faced, AWWA C115. Submit certification that flanges comply with AWWA C115.
3. Fittings:
 - a. Flanged: Ductile iron, AWWA C110 or AWWA C153.
 - b. Buried bolts and nuts for flanged and grooved end joints shall be Type 316 stainless steel.
4. Lining:
 - a. Ceramic Epoxy Lining, Induron Protecto 401 or approved equal.
5. Coating: Buried pipe shall receive asphalt coating per AWWA C115. Exposed or submerged pipe requiring protective coating per Section 09960 shall be shipped bare or shall be factory primed compatible with selected field paint system.
6. Gaskets:
 - a. Flanged: Full-face, 1/8-inch thick SBR rubber, AWWA C115, Appendix A.
7. Flange Bolts: AWWA C115, Appendix A unless stainless steel is required in paragraph 2.02.
8. Pipe Taps:
 - a. Direct threaded taps are not acceptable. Pipe branch line connections shall be made using service saddles, by using reducing flanges on tees, or by tapping blind flanges on tees.
 - b. Threaded metal pipe branch lines up to 1-inch in diameter from ductile iron pipe may be made with direct threaded taps, provided the ductile iron wall thickness is in excess of the minimum shown in Tables A.1 and A.2 of AWWA C151 for four full threads. Bosses may be used at the taps to provide the required pipe wall thickness or use service saddles or reducing flanges on tees.
 - c. Service Saddles:
 - 1) Materials: Ductile iron saddle with electro-galvanized straps and hardware for aboveground and bronze or 304 stainless steel for buried, and nitrile or neoprene gaskets.
 - 2) Type: For ductile iron pipe 4 inches and less, single strap saddles may be used. For pipe greater than 4 inches, double-strap saddles shall be used.
 - 3) Manufacturers: Smith-Blair; equivalent by Mueller; or approved equal.
9. Field Closure Connections for Restrained Joints: Pipe cut in the field where necessary and when favorably reviewed by the Engineer shall be connected by one of the following methods:
 - a. Series 3800 Mega-Coupling by EBAA Iron, Inc.; or approved equal.
 - b. Mechanical Joint Sleeve with two Series 1100 Megalug Restraints by EBAA Iron, Inc.; or approved equal.

H. PVC-1 PIPE:

1. Pipe: Schedule 80 polyvinyl chloride (PVC), gray, normal impact, Type 12454 B, ASTM D1784 and ASTM D1785. Pipe shall bear the National Sanitation Foundation (NSF) label.
 2. Joints: Solvent weld, except flanged or threaded permitted where required at equipment connections and where required on the Drawings. Use Military Specification T 27730A tape for threaded joints.
 3. Fittings: Solvent weld, socket type, of same material as the pipe, Schedule 80, ASTM D2467.
 4. Cement: Solvent weld, ASTM D2564, as recommended by the pipe manufacturer for the schedule and size to be joined, PVC 724 by Weld-On; no equal.
 5. Pipe Cleaner: As recommended by the pipe manufacturer for the schedule and size to be joined.
- I. PVC-4 PIPE: buried pressure service, see Section **02513**.
- J. PVC-5 PIPE: buried gravity service, see Section **02514**.
- K. PVC-6 PIPE:
1. Pipe and Fittings: Polyvinyl chloride drain, waste and vent, ASTM D2665. Fitting patterns, ASTM D3311.
 2. Joints: Solvent weld.
 3. Cement: Solvent cement, ASTM D2564, as recommended by the manufacturer.
- L. SSP Pipe:
1. Pipe: Stainless steel, ASTM A312 or A778 except that caustic pipe shall be A312 only, 316L, Schedule 40S, 80S, except Schedule 40S for screwed joints and pipe 6 inches and smaller.
 2. Joints: Butt welded *or socket welded OR mechanical grooved couplings*, except where screwed or flanged joints are required adjacent to valves or equipment. *Cut or rolled groove connections, AWWA C606*.
 3. Fittings: Wrought stainless steel, ASTM A774, TP316L, TP304L, *except that caustic system shall have ASTM A403, TP 316L fittings only*. Dimensions shall be in accordance with ANSI B16.9.
 4. Flanges: Welding neck or slip-on, raised face, ASTM A182, TP316L, TP304 ANSI B16.5 for dimensions. Class 150, drilling to match adjacent accessories or valves. Flanges (including bolts and threaded rods) for water/wastewater service shall be in accordance with AWWA C228.
 5. Gaskets: Full face gasket per ANSI B16.21, See Valve and Accessory System for materials.
 6. Descale pipe per ASTM A380 and remove all heat tint. Passivate after fabrication per ASTM A380 with final cleaning per Table A.2.1 Part 11 and per ASTM A967.

2.04 PIPE COUPLINGS AND FLEXIBLE PIPE PIECES

- A. **General:** For typical pipe joints refer to pipe material specifications. Other joint devices shall be furnished where called for on the Drawings and as specified below.
- B. **FLEXIBLE COUPLINGS AND FLANGE COUPLING ADAPTORS:**
 - 1. Sleeve: Cast iron or fabricated steel.
 - 2. Followers: Cast iron, ductile iron, or steel.
 - 3. Sleeve Bolts: ASTM A325, Type 3; malleable iron; or equivalent, except for buried and submerged, which shall be Type 304 stainless steel and Type 316 stainless steel, respectively.
 - 4. Coating: Fusion epoxy OR High-build epoxy line and coat sleeve and followers.
 - 5. Pressure Rating: The test pressure of the applicable service or 50 psi, whichever is greater.
 - 6. Performance: Longitudinal movement and angular deflection capabilities shall meet AWWA C219.
 - 7. Flanged Coupling Adaptor Flanges: Match mating flanges. If required by connecting valve or other device, provide flanges with inside diameter equal to nominal pipe diameter.
 - 8. Buried Flexible Coupling Sleeve: Long barrel; Smith-Blair 442, Dresser Style 40; or approved equal.
 - 9. Manufacturers:
 - a. Flexible Couplings:
 - 1) Connecting Pipe with Identical Outside Diameters: Smith-Blair 411 or 441; Dresser Style 38 or 138; or approved equal.
 - 2) Connecting Pipe with Slightly Different Outside Diameters: Smith-Blair 413 or R441; Dresser Style 62; or approved equal.
 - b. Flange Coupling Adaptors: Smith-Blair 912 or 913; Dresser Style 128 W; or approved equal.
 - 10. Gaskets: SBR rubber or oil and grease resistant (Nitril or Buna-N).
 - 11. Joint Restraint: Provide joint harnesses (tie rod lug or attachment plate assemblies) designed for the test pressure or 50 psi, whichever is greater, across all flexible couplings and flange coupling adaptors, except where specifically indicated otherwise on the Drawings. For steel pipe, the joint harness shall conform to the requirements of Chapter 13 of AWWA M-11, Table 13 4 - Tie Bolt Schedule for Harnessed Joints. Anchor studs may be used on flange coupling adapters for pipe up to 12 inches in diameter.
 - 12. Protection for Buried Couplings and Adaptors:
 - a. Double-wrap with polyethylene encasement, AWWA C105 and tape the edges of the encasement with PVC tape.
 - b. Tape: Denso Tape; or approved equal.

2.05 VALVES AND ACCESSORIES

A. Valve and Accessory System Designation: Most valves and accessories to be furnished and installed are identified by a valve and accessory system designated by a letter symbol in the Pipe Schedule.

B. GENERAL REQUIREMENTS FOR VALVES:

1. All valves of each type shall be the product of one manufacturer.
2. All exposed valves shall be furnished with operators, handwheels, levers, or other suitable type wrench including handles as specified herein or as shown on the Drawings. Valves 4-inch and larger located more than 7 feet above the floor level shall be furnished with chain operators. Chains shall be galvanized and shall extend to within 3 feet of the floor. Provide hook so that chain may be stored clear of walkways. All buried valves shall be provided with 2-inch-square operating nut and valve boxes.
3. All threaded stem valves shall open by turning the valve stem counter-clockwise.
4. All exposed valves and valve operators shall have a non-bleeding shop coat, unless otherwise specified. General Requirements for Accessories: Pressure Gauges: Provide shutoff valves for all pressure gauges. Conform to additional requirements in this Section below.

C. VALVE AND ACCESSORY SYSTEMS:

1. Valve and Accessory System A: Applicable Service Condition: Clean Water, recycled water, and air.
 - a. Ball Valves through size 4-inch in metal piping:
 - 1) Rating: 400 psi WOG (Water, Oil, Gas).
 - 2) Type: Lever.
 - 3) Connections: Threaded.
 - 4) Materials: Bronze body, chrome-plated ball, Teflon seats.
 - 5) Manufacturers: Apollo 70-100; Watts B 6000; or approved equal.
 - b. Propeller Flowmeter
 - 1) Propeller meters shall feature a magnetic drive which shall prevent the process fluid from contacting any gears, bearings, shafts, etc., within a hermetically meter register. The rotation of the propeller shall be transmitted via the magnetic drive to the register and transmitter (where required) by means of a rigid shaft. The propeller shall be of 3-bladed conical design, constructed of rigid plastic that will not flex or otherwise change in dimension under maximum fluid velocity through the meter. The register case shall be hermetically sealed with a hinged lens cover and clasp.

- 2) All wetted parts of meters and straightening vanes shall be corrosion resistant and compatible with the recycled water. Meters shall be manufactured to comply with all applicable requirements of AWWA C704. All flanged-tube type meters shall mate with 150 pound flanges.
 - 3) Straightening vanes shall be furnished and installed upstream from the meter according to the manufacturer's recommendations. Each propeller meter shall register flow to within $\pm 2\%$ of actual flow rate. Meters shall be provided a watertight or hermetically sealed register consisting of a rate indicator and 6 digit totalizer. The register shall be connected to the tube by means of flanged connection designed for easy removal for inspection or repair. A compression seal shall be used to seal the register to the tube.
 - 4) A certified copy of the calibration taken at or near minimum flow rating, at midrange, and at the highest flow rate within the range attainable by the test facility shall be furnished to the Engineer for favorable review.
 - 5) Manufacturer: Water Specialties Model ML04-D; Sparling; or equal.
2. Valve and Accessory System B: Applicable Service Conditions: drainage, sewage and wastewater at working pressures to 100 psig.
 - a. Plug valves 2-inch and larger: See Section 15117.
 - b. Check Valves: See Section 15115.
 - c. Pressure Gauges:
 - 1) Complete installation, unless otherwise shown, shall include $\frac{3}{4}$ -inch plug valve isolation at the main, a diaphragm seal made specifically for solids handling service, a snubber if over 5 psi operating pressure and gauge. Provide a support plate to the nearest flange.
 - 2) Plug Valve: Shall be DeZurik PEC; Val-Matic 5800 or approved equal. Connections shall be threaded.
 - 3) Diaphragm Seal: Shall be for slurry service with flushing connection. Body shall be stainless or carbon steel. Diaphragm shall be oversized and be removable of Type 316 stainless steel. Complete unit shall be Trerice Series 600, Ashcroft Model 100; or approved equal.
 - 4) Gauges and Snubbers: Shall be as specified for System A.
 - 5) Installation: All protectors and gauge bourdon tubes shall be evacuated of air, silicone filled at the factory and factory calibrated.
 - d. Air Valves:
 - 1) Standard: AWWA C512, except as modified herein.
 - 2) Sewage Combination Air Valves (SCAVs):
 - a) Function: Exhausts large volumes of air during pipeline filling and allows air back in when pipeline pressure

- drops below atmospheric pressure. Keeps sewage from air openings by incorporating deep body.
- b) Materials: Stainless steel body, stainless steel float.
 - c) Pressure rating: 150 psi.
 - d) Non-slam
 - e) Manufacturer: A.R.I. D-025; or approved equal.
3. Valve and Accessory System D:
- a. Applicable Service Condition: Fuel oil at pressures to 100 psig.
 - b. Gaskets shall be Nitrile unless noted otherwise.
 - c. Ball Valves:
 - 1) Rating: 500 psi WOG (Water, Oil, Gas).
 - 2) Type: Lever operated, double seal, UL listed.
 - 3) Connections: Threaded.
 - 4) Materials: Type 316 stainless steel body and ball, Teflon seats.
 - 5) Manufacturers: Jamesbury A36TT; Crane 950 TRE; or equal.
 - d. Check Valves:
 - 1) Rating: 250 psi WOG (Water, Oil, Gas).
 - 2) Type: Y-pattern swing check.
 - 3) Connections: Threaded.
 - 4) Materials: All iron.
 - 5) Manufacturers: Jenkins Figure 72; Walworth Figure 904; or equal.
 - e. Strainers:
 - 1) Rating: 200 psi WOG (Water, Oil, Gas).
 - 2) Type: Y-pattern, 40-mesh screen.
 - 3) Connections: Threaded.
 - 4) Material: Malleable iron or semi steel body, brass screen.
 - 5) Manufacturers: Crane 988 1/2, Hoffman 410, or equal.
 - f. Pressure Gauge Assembly: See 17150. Bourdon tube shall be stainless steel.
 - g. Solenoid Valves: Solenoid valves for fuel oil service shall be packless normally closed valves with forged brass body and Buna N resilient seat. Valve body shall have a 300 psi working pressure rating. Valve shall be capable of operating at differential pressures up to 125 psi. Coil shall have Class F insulation for 120-volt ac continuous duty with explosion-proof watertight enclosure. Valves shall be Asco; Skinner; or equal.

PART 3 - EXECUTION

3.01 PIPING INSTALLATION

A. GENERAL HANDLING AND PLACING:

1. Exercise great care to prevent injury to or scoring of the pipe lining and coating, as applicable, during handling, transportation or storage. Handle fusion epoxy coated pipe and ceramic epoxy lined pipe in accordance with AWWA C213. Do not store pipe on rough ground and do not roll the pipe on the coating. Any damaged pipe sections, specials, or fittings shall be repaired or replaced at the expense of the Contractor as satisfactory to the Engineer.
2. Carefully inspect each pipe, fitting, valve and accessory before installation to insure there is no defective workmanship or obstructions. Inspect the interior and exterior protective coatings and patch all damaged areas in the field or replace to the satisfaction of the Engineer.
3. Place or erect all piping to accurate line and grade and backfill, support, hang, or brace against movement as specified or shown on the Drawings, or as required for proper installation. Remove all dirt and foreign matter from the pipe interior prior to installation and thoroughly clean all joints before joining.
4. Use reducing fittings where any change in pipe size occurs. Do not use bushings unless specifically noted on the Drawings. Use eccentric reducing fittings wherever necessary to provide free drainage of lines.
5. Cast all metallic pipes and sleeves 6-inch and larger into new concrete walls without blockout. Pipes 5 inches and smaller may be cast in place or installed in a smooth core drilled hole using a link type seal at the Contractor's option. Maintain at least $\frac{1}{2}$ -inch clearance between reinforcing steel and metal pipe in penetrations.
6. Cover polyvinyl chloride (PVC) pipe stored outside for more than two months with canvas or other opaque material. Provide for air circulation under the covering.

B. GENERAL BURIED PIPING INSTALLATION:

1. Trenching, bedding, and backfill for buried piping shall be as shown on the Drawings and as specified in Section 02300.
2. Where pipe grade elevations are shown on the Drawings, install the pipe with straight grades between the indicated elevations.
3. Where no pipe grade elevations are shown on the Drawings, install buried piping with at least 3 feet of cover to finished grade. Where piping crosses under buried electrical ducts, provide at least 4 feet 6 inches of cover. Provide 12 inches minimum separation between the buried pipes and ducts.

4. Provide each pipe with a firm, uniform bearing for its full length in the trench except at field joints. Do not lay pipe in water or when trench conditions or weather are unsuitable for such work.
5. Protect buried piping against thrust by use of restrained pipe joints and/or thrust blocks. All exposed free pipe ends shall be securely braced. Cap or plug pipe ends that are left for future connections as shown on the Drawings and in a manner favorably reviewed by the Engineer.
6. Where piping leaves a structure or concrete encasement, provide a joint capable of angular deflection within 12 inches of the structure for pipes 12-inch and smaller. Conform to details on the Drawings where such details are shown.
7. Snake buried PVC pressure pipe from side to side in the trench in long sweeps.
8. Concrete Encasements: All piping and conduits except plumbing lines installed under slabs or footings on earth or crushed rock shall be encased in concrete not less than 6-inch thickness on all sides and extending up to the bottom of the slab or footing, unless otherwise specifically noted on the Drawings. Encasement shall extend to within 6 inches of the first pipe joint beyond the slab or footing. Provide concrete encasement whether or not the encasement is shown on the Drawings. Provide encasement under slabs on earth or crushed rock even if the structure is supported on piles, caissons, or footings. Provide continuous concrete cradles where shown.
9. Do not pull bell and spigot, gasketed joints more than 75% of the maximum deflection permitted by the pipe manufacturer.
10. Double Containment for Buried Chemical Tubing: Enclose buried chemical tubing within Type V-1 Pipe. Terminate at watertight junction boxes.
11. Coat bolts on buried flanges or other buried appurtenances in accordance with Paint System 8 in Section 09960. Wrap the appurtenance with polyethylene encasement and tape the encasement tightly closed to the pipe.

C. GENERAL EXPOSED PIPING INSTALLATION:

1. Unless shown otherwise, install piping parallel to building lines, plumb and level.
2. Install piping without springing or forcing the pipe in a manner that would set up stresses in the pipe, valves, or connected equipment.
3. Set all pipe flanges level, plumb, and aligned. All flanged fittings shall be true and perpendicular to the axis of the pipe. All bolt holes in flanges shall straddle vertical centerline of pipes.
4. Flexibility and Expansion: Provide flexible couplings, flexible hose, or flexible spools for all piping connections to motor driven equipment and where otherwise shown. The Contractor may install additional flexible couplings at favorably reviewed locations to facilitate piping installation,

- provided that he submits complete details describing location, pipe supports, and hydraulic thrust protection. Anchor piping subject to expansion or contraction in a manner permitting strains to be evenly distributed. Sleeves for branches through walls from adjacent mains shall be of sufficient size to allow for free side motion of covered pipe in sleeves.
5. Install unions or flexible connections where shown on the Drawings, and at all non-motor-driven equipment to facilitate removal of the equipment.
 6. Provide valves wherever equipment drain connections are furnished and carry the discharge pipe to the nearest floor drain, drain trench or sump. Where no receptacle for drain exists, install drain piping to 1 inch above the floor. Drain piping and valve materials shall conform to the requirements of the system served.

D. PIPE WELDING:

1. General: Unless specified otherwise, shop and field welding of pipe shall conform to ANSI B31.1 as amended by this paragraph.
2. All field and shop welding shall be done by the electric arc process unless otherwise specified. All field welding shall be done in passes not thicker than 1/4-inch. Size and type of electrodes, and current and voltages used, shall be subject to the favorable review of the Engineer. Give particular attention to the alignment of edges to be joined, so that complete fusion and penetration will be affected throughout the bottom of the weld. Welds shall contain no valleys or undercuts in the center or edges of the weld. Thoroughly clean each pass, except the final one, of dirt, slag, and flux before the succeeding bead is applied.
3. Clean completed field welds of pipe joints of dirt, slag and flux, and then visually inspect. Completely chip out all defects in welds discovered during field inspection in a manner that will permit proper and complete repair by welding subject to the favorable review of the Engineer. Under no circumstances will caulking of defective welds be permitted.
4. All welding shall be done by experienced, skilled operators familiar with the methods and materials to be used. Hand welding will be done only by welders qualified under the standard qualification procedure of Section IX of the ASME Boiler and Pressure Vessel Code.
5. Field welds shall follow as closely as possible to the laying operation. All field welds shall be complete before lining or coating of the joints in steel pipe is begun. Where pipe is fusion epoxy lined and/or coated, follow AWWA C-213 procedures for field welded joints.
6. A single, continuous, watertight, full fillet weld shall be the minimum required at all field joints. Double welded joints are required on all piping specifically noted to be double welded.
7. See also installation specifics for welding of pipe.
8. Where piping conveying liquids passes over motor control centers, electrical panels and other electrical devices, install a protective drainage tray below the piping.

E. INSTALLATION SPECIFICS:

1. CUP Pipe:
 - a. Bends shall be made in a manner that does not crimp or flatten pipe.
 - b. Dielectric unions shall be installed at connections with ferrous piping.
 - c. Pipe shall have joints squarely cut clean, soldered joints shall be properly fluxed and heated before solder is placed in the joint. Joints must be driven up tight before solder is added. Compression and flared joints shall be made up in accordance with the fitting manufacturer's installation instructions. Brazing shall be in accordance with ANSI B31.1.
 - d. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Provide space to permit insulation applications, with 1-inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.
 - e. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, $\frac{3}{4}$ -inch ball valve, and short $\frac{3}{4}$ -inch threaded nipple and cap.
 - f. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using steel sleeves and mechanical sleeve seals.
 - g. Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings, and floors, maintain the fire rated integrity.
 - h. Install branch connections to mains using tee fittings in main with take-off out the bottom of the main, except for up-feed risers, which shall have take-off out the top of the main line.
 - i. Install strainers on the supply side of each control valve, pressure reducing valve, pressure regulating valve, solenoid vale, inline pump, and elsewhere as indicated. Install nipple and ball valve in blowdown connection of strainers 2 inches and larger.
2. Black Steel (BS):
 - a. Install and weld in accordance with ANSI B31.1.
 - b. Threaded joints shall have connections metal-to-metal tight. Remove all burrs from the ends of the pipe and clean threads of all oil and chips. Coat male threads with a joint lubricant.
 - c. Install double contained diesel fuel piping in accordance with the manufacturer's recommendations.
3. DIPF Pipe:
 - a. Flanged Joints: Flanged joints shall be made up tight with care being taken to avoid undue strain in the flanges, fittings, and other accessories. Bolt holes shall be aligned for each flanged joint. Bolts shall be full size for bolt holes; use of undersize bolts to make up for misalignment of bolt holes or for any other purpose will not be

permitted. Adjoining flange faces shall not be out of parallel to such a degree that the flanged joint cannot be made watertight without overstraining the flange. Any flanged pipe or fitting whose dimensions do not allow the making of a proper flanged joint as specified herein shall be replaced by one of the proper dimensions. Clean flanges prior to making joints. Buried flanged pipe connections shall be made with the smallest practical "bell" hole. After the joint is completed take special care to completely fill the "bell" hole under and around the pipe with compacted backfill.

4. PVC-6 Pipe:
 - a. Install pipe in accordance with the manufacturer's instructions.
 - b. Place PVC pipe within the installation areas at least 24 hours prior to installation to permit temperature equalization.
 - c. Cut pipe ends squarely, ream and deburr inside and out.
 - d. Clean pipe ends and bells of dirt, grease and other foreign materials prior to making the joint.
 - e. Solvent Weld Joints: Clean pipe ends and sockets and join in strict conformance with the pipe manufacturer's instructions. Make joints in accordance with ASTM D2855. Handle solvent cements and primers in accordance with ASTM F402.
 - f. Containment fittings for chemical and chemical solution lines shall be installed and tested in accordance with manufacturers' instructions. Install containment pipe with position clips at 3-foot centers and at fittings during installation of carrier pipe. Do not make joints until after successful leak tests of carrier pipes.
5. SSP Pipe:
 - a. Install and weld in accordance with CGA G-4.4 and ANSI B31.3. Back purge all welds with cover gas. Seal weld all slip-on flanges.
 - b. Provide anti-seize compound on threaded connections.
 - c. Temporarily plug or cap all points of connection to exclude moisture, dust or other contaminants or impurities prior to being connected.

3.02 COUPLING INSTALLATION

- A. Flexible Couplings and Flange Coupling Adaptors: Prior to installation, thoroughly clean oil, scale, rust, and dirt from the pipe to provide a clean seat for the gasket. Wipe gaskets clean before they are installed. If necessary, flexible couplings and flanged coupling adapter gaskets may be lubricated with soapy water or manufacturer's standard lubricant before installation on the pipe ends. Install in accordance with the manufacturer's recommendations. Tighten bolts progressively, drawing up bolt on opposite sides a little at a time until all bolts have a uniform tightness. Workers tightening bolts shall be equipped with torque-limiting wrenches or other favorably reviewed type. Anchor studs on restrained flanged coupling adaptors shall be installed so as to lock into holes drilled through the pipe wall in accordance with manufacturer's recommendation.

B. Tie Rods: Except where double-nutting is required, install the nuts snug. Tighten the nuts gradually and equally at opposite sides of the pipe until snug to prevent misalignment and to ensure that all rods carry equal loads. If double-nutting is required, double-nut each end of each tie rod. The space between the pairs of nuts shall be $\frac{1}{2}$ -inch greater than the distance between the lugs. Provide double-nutting at buried locations and where otherwise required on the Drawings.

C. FLEXIBLE RUBBER SPOOLS:

1. Install in accordance with manufacturer's instructions. Install with one-half the maximum expansion.
2. Connect rubber spools only to full-face metal flanges.
3. Install control rod-compression sleeve assemblies with control rod nuts snug, to relieve stress on adjacent pipe, except at buried locations. Comply with manufacturer's instructions.
4. Paint buried galvanized steel retainer rings, bolts and other appurtenances in accordance with Section 09960.

3.03 INSTALLATION OF VALVES AND ACCESSORIES

- A. Wrap buried valve bodies as specified for flexible couplings and flanged coupling adapters.
- B. Use reducing fittings where any change in pipe size occurs between valves or accessories and the attached pipeline. Bushings shall not be used, unless specifically noted on the Drawings. Use eccentric reducing fittings wherever necessary to provide free drainage of lines.
- C. Install valves and accessories such that all parts are easily accessible for maintenance and operation. Provide valve boxes for buried valves.
- D. Where valve handwheels are shown on the Drawings, valve orientation shall be as shown. Where valve handwheels are not shown, orient valves to permit easy access to the handwheels or handles and to avoid interferences.
- E. Install pressure gauges in a position to permit reading them from a point approximately 5 feet above floor level, except that pump pressure gauges shall be installed close to the pump elevation.
- F. Rigidly support pressure switches and connect them to piping and equipment using a suitable flexible linkage that will not permit transmission of vibrations from the piping or equipment to the pressure switches.
- G. Provide a union adjacent to each screwed end valve and accessory with additional unions as necessary to facilitate removal.

- H. Provide a shutoff valve below each pressure gauge, protective device or air valve unless otherwise specified.
- I. Connections between ferrous and non-ferrous piping, valves, accessories or pipe supports shall be made using a dielectric coupling, union, or flange.
- J. Where valves or other pipeline items require metal full-face connecting flanges, provide intermediate flanges if the connecting flange is not adequate.
- K. All insulated piping passing through walls or slabs shall be sleeved and insulation shall run continuously through the sleeves and shall allow for 1/8 inch annular clearance between outside of insulation and sleeve wall.
- L. Provide a suitable chrome plated escutcheon on pipes passing through walls, floors, ceilings and partitions in finished areas.
- M. Provide test plugs on all closed water systems and condenser water systems located in inlet and outlet of coils, heat exchangers, cooling towers, and where indicated on Drawings. Locate test plugs where they will be easily accessible, have adequate clearance for insertion and removal of gage needles and thermometer stems, and position to allow unobstructed viewing of gages and thermometers.

3.04 PIPE AND VALVE IDENTIFICATION

- A. General: Identify all exposed piping in this project by painting, banding, system name labels, and direction arrows. The color and banding shall be as specified in the County's Equipment and Piping Color Identification Code. Identify all buried and exposed valves with tags as specified below.
- B. Exposed Pipe Identification: Before painting, banding and labeling, pipes shall be identified by the Contractor with temporary wired-on cardboard tags showing the proposed marking for review by the Construction Manager.
- C. Piping: Paint all exposed pipes with the appropriate paint system as specified in Section 09960.
- D. Valves: Provide each buried valve with a valve tag identifying the pipeline contents, and either its valve number, or the area or item served by the valve for valves without a valve number. Contents shall be as designated in the Piping Schedule.

3.05 FIELD QUALITY CONTROL

- A. Factory Quality Control: The Contractor shall test all products as required herein and by the reference specifications.
- B. The Contractor shall:

1. Perform leakage tests.
2. Be responsible for the costs of additional inspection and retesting by the County resulting from non-compliance.

3.06 CLEANING

- Prior to testing, thoroughly clean the inside of each completed piping system of all dirt, loose scale, sand and other foreign material. Cleaning shall be by sweeping, flushing with water or blowing with compressed air or oil-free nitrogen gas, as appropriate for the size and type of pipe. Flushing shall achieve a velocity of at least 3 feet per second. The Contractor shall install temporary strainers, temporarily disconnect equipment, or take other appropriate measures to protect equipment while cleaning piping. Cleaning shall be completed after any pipeline repairs.

3.07 FIELD TESTING

- General:** Perform leakage tests on all pipe installed in this project. Furnish all equipment, material, personnel and supplies to perform the tests and make all taps and other necessary temporary connections. The test pressure, allowable leakage and test medium shall be as specified or as shown on the drawings. Test pressure shall be measured at the highest point on the line, except that pressure at lowest point shall not exceed pipe manufacturer's rated test pressure, unless specifically noted otherwise. Leakage tests shall be performed on all piping at a time agreed upon and in the presence of the Engineer. All visible leaks shall be repaired, regardless of the test results.
- Buried Piping:** The leakage test for buried piping shall be made after all pipes are installed and backfilled. However, the Contractor may conduct preliminary tests prior to backfill. If the Contractor elects to conduct preliminary tests, provide any necessary temporary thrust restraint.
- Exposed Piping:** All supports, anchors and blocks shall be installed prior to the leakage test. No temporary supports or blocking shall be installed for final test.
- Encased Piping:** The leakage test for encased piping shall be made after all pipe is installed and encased, and before any structures are constructed above it. However, the Contractor may conduct preliminary tests prior to encasement. If the Contractor elects to conduct preliminary tests, provide any necessary temporary thrust restraint.
- Accessories:** It shall be the responsibility of the Contractor to block off or remove equipment, valves, gauges, etc., which are not designed to withstand the full test pressure.

- F. Testing Apparatus: Provide pipe taps, nozzles and connections as necessary in piping to permit testing including valves to isolate the new system, addition of test media, and draining lines and disposal of water, as is necessary. These openings shall be plugged in a manner favorably reviewed by the Engineer after use. Provide all required temporary bulkheads.
- G. Correction of Defects: If leakage exceeds the allowable, the installation shall be repaired or replaced and leakage tests shall be repeated as necessary until conformance to the leakage test requirements specified herein have been fulfilled. All visible leaks shall be repaired even if the pipeline passes the allowable leakage test.
- H. Reports: The Contractor shall keep records of each piping test, including:
1. Description and identification of piping tested.
 2. Test pressure.
 3. Date of test.
 4. Witnessing by Contractor and Engineer.
 5. Test evaluation.
 6. Remarks, to include such items as:
 - a. Leaks (type, location).
 - b. Repairs made on leaks.
 7. Test reports shall be submitted to the Engineer.
- I. Venting: Where not shown on the Drawings, the Contractor may install valved "tees" at high points on piping to permit venting of air. Valves shall be capped after testing is completed.
- J. Testing Specifics: Piping shall be tested as indicated in the Pipe Schedule shown on the Drawings. Unless specified otherwise, test each system for 4 hours.

END OF SECTION

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SECTION 15060

PIPE SUPPORTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Provide all pipe supports as shown on the Drawings, described in the Specifications.

1.02 REFERENCES

- A. American Institute of Steel Construction (AISC), Manual of Steel Construction
- B. American Society of Mechanical Engineers (ASME), ASME B31 Code for Pressure Piping
- C. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
- D. ASTM International (ASTM)
- E. MANUFACTURERS STANDARDIZATION SOCIETY (MSS):
 - 1. MSS SP-58: Pipe Hangers and Supports - Materials, Design, and Manufacture
 - 2. MSS SP-69: Pipe Hangers and Supports - Selection and Application
 - 3. MSS SP-89: Pipe Hangers and Supports - Fabrication and Installation Practices
- F. American National Standards Institute (ANSI)
- G. American Water Works Association (AWWA)
- H. National Fire Protection Association (NFPA)
- I. SMACNA Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Piping Systems

1.03 SUBMITTALS

A. SHOP DRAWINGS:

- 1. Layouts and Schematics: Submit detailed installation drawings of all piping. Schematics may be submitted for piping 4 inches and smaller. The Drawings and schematics shall include: pipe support locations and types, fittings, valves, other appurtenances. (Product Review)

2. Submit data to show that the following items conform to the Specification requirements:
 - a. Fabricated pipe supports and other pipe supports (Product Review).
 3. Submit certified test reports as required herein and by the referenced standard specifications (Product Information).
- B. Provide seismic anchorage design for Contractor designed pipe supports in accordance with Section 01190, including layout and calculations, signed and sealed by a Professional Civil or Structural Engineer registered in the State of Hawaii.

1.04 QUALITY ASSURANCE

- A. Materials and equipment furnished under this Section shall be of manufacturers who have been regularly engaged in the design and manufacture of the materials and equipment for a period of at least 5 years. Demonstrate to the satisfaction of the Engineer that the quality is equal to the materials and equipment made by the manufacturers specifically named herein, if an alternate manufacturer is proposed.

1.05 APPURTENANCES

- A. Furnish and install all necessary anchors and assembly bolts, washers and nuts, hangers, and supports; all other appurtenant items shown on the Drawings, specified or required for the proper installation and operation of the pipe supports.

1.06 PIPE SUPPORTS

A. GENERAL:

1. Piping 6 Inches and Larger: Pipe supports are shown on the Drawings for piping 6 inches and larger in diameter, where the piping is shown on layout drawings. Each pipe support used is designed to resist seismic loading except where the support is of the sliding type for thermal expansion. Other supports are provided to resist axial seismic loading of pipes designed for thermal expansion. Pipe supports that are considered seismic resistant are so noted on the pipe support detail sheets on the Drawings. The location and types of supports and braces are indicative and may be modified by the Contractor to suit field conditions, provided the modified support system conforms to the design criteria stated herein, and receives the favorable review of the Engineer. Where piping is shown schematically only, it shall be the Contractor's responsibility to support all such piping in accordance with the design criteria stated herein and using support details shown on the Drawings. Pipe supports have been designed assuming flanged joints on ductile

iron pipe and steel pipe, unless otherwise indicated on the Drawings. If groove type mechanical couplings are used as an alternative, provide additional supports where required, particularly to resist rotation. Shop drawings of these additional supports shall be favorably reviewed by the Engineer prior to installation.

2. Piping Less Than 6 Inches: Pipe supports are generally not shown for piping less than 6 inches in diameter. Where supports are not shown, it shall be the Contractor's responsibility to support all such piping in accordance with the design criteria stated hereinafter and the support details shown on the Drawings. Piping 2-1/2 inches and larger and all piping for hazardous chemicals shall be supported with pipe supports designed to resist seismic loads. Hazardous chemical piping includes fuel. Piping smaller than 2-1/2 inches with non-hazardous contents may be supported with non-seismic resistant supports.
3. Where not detailed or otherwise indicated, pipe support types and spacing shall be in accordance with the Manufacturer's Standardization Society (MSS) Standard Practice No. SP 58 and No. SP 69, except as superseded by the requirements of these Specifications. Hangers and supports used as components of a fire protection system shall comply with NFPA Standard No. 13 and be listed and labeled by UL and FM.
4. Provide supports for exhaust silencers, exhaust piping, and vent piping in accordance with MSS SP-58 and SP-69. Supports shall be designed to accommodate thermal expansion, vibration, and seismic loads. Coordinate with structural drawings for anchorage and bracing. Where silencers are mounted vertically, provide drainage provisions and seismic restraint as required.

B. PIPE SUPPORT SYSTEM DESIGN:

1. Design Loads: Pipe suspension shall be such as to prevent excessive stress or excessive variation in supporting force while system is in operation. Pipe supports shall support the sum of the weight of the pipe, fittings, appurtenances, and contents. In addition, the pipe shall be anchored to resist internal pressure forces tending to separate any unrestrained joint at pressures 1-½ times the maximum working pressure for the applicable service.
2. Seismic Loads: Refer to Section 01190.
3. Location: All piping shall be supported in a manner that will prevent undue strain on any valve, fitting, or piece of equipment. In addition, pipe supports shall be provided at changes in direction or elevation, adjacent to flexible couplings, at all non-rigid joints, at hose bibbs, and where otherwise shown. Where piping connects to equipment, it shall be supported by a pipe support and not by the equipment.
4. Exhaust System Loads: Exhaust piping and silencers shall be supported to resist the combined effects of weight, thermal expansion, vibration, and seismic forces. Supports shall not impose loads on the silencer

casing or generator connections. Provide flexible connectors where required to isolate vibration.

- a. Maximum support spacing shall conform to the following table:

Pipe Size Inches	Pipe Material	Maximum Spacing Feet
1-inch and smaller	Iron or Steel Copper Plastic Tubing	6 4-1/2 continuous continuous
1-1/4-inch to 2-inch	Iron or Steel Copper or Plastic	8 5
2-1/2-inch to 4-inch	Iron or Steel Copper or Plastic	10 6
6-inch to 8-inch	Iron or Steel Plastic	12 8
10-inch and larger	Iron or Steel	15

- b. Piping penetrations through concrete walls and slabs are considered to resist seismic loading, provided penetrations for pipes 3 inches in diameter and larger are complete with a wall flange.
- c. Branch piping is not considered to provide resistance to seismic forces.
5. Anchors: Anchors for connecting pipe supports to concrete shall be in accordance with Section 05100.
6. Thermal Expansion Allowance:
 - a. Provide one rigid pipe support for each straight run of pipe and between each pair of flexible couplings, flexible connectors, or expansion loops for pipes listed below. Provide other supports at the required spacing that allow sliding or rolling, as noted, along the pipe axis:
 - 1) PVC pipe larger than 1-inch in diameter (sliding inside PVC sleeve).
 - b. Provide vertical support only, that is, no lateral support, within 4 feet of an angle or tee for pipes listed above.

PART 2 - PRODUCTS

2.01 GENERAL MATERIAL REQUIREMENTS

- A. Unless specified otherwise herein bolts, nuts, and other hardware shall be as follows:
 1. Type 316 stainless steel
 2. Apply an anti-galling compound to the threads of stainless steel bolts.

2.02 PIPE SUPPORTS

- A. Manufacture and Design: Pipe supports shall to the maximum extent possible be standard factory fabricated units conforming to the typical supports and braces shown in the Drawings and as specified below. Where required support cannot be provided by standard factory fabricated units, and is not detailed on the Drawings, the Contractor shall provide special pipe supports. Supports shall be manufactured or special fabrications or combination as shown on the Drawings or specified. Special fabrications shall be in conformance with Section 05500. Provide $\frac{3}{4}$ -inch chamfer on corners of all support elements and file or grind smooth. Supports designated to allow axial pipe movement shall have smooth and even contact surfaces.
- B. For exhaust silencers and piping, supports shall include vibration-isolated hangers, brackets, or structural frames as required. Where silencers are not detailed on the Drawings, the Contractor shall submit shop drawings for review, showing support configuration, anchorage, and thermal movement allowances.
- C. **MANUFACTURERS:**
 - 1. Anvil International
 - 2. Eaton B-Line
 - 3. Or equal.
- D. The shield shall consist of an insulation layer encircling the entire circumference of the pipe and a steel jacket encircling
- E. Materials: All support systems shall be Type 316 stainless steel.
- F. Provide plastic caps with rounded corners on all exposed ends of channels.

PART 3 - EXECUTION

3.01 INSTALLATION OF PIPE SUPPORTS

- A. **GENERAL:**
 - 1. Install and adjust supports for each pipeline such that the pipeline is true to the indicated line and grade.
 - 2. Locate anchors and braces for any single support on a continuous structure; that is, not on two sides of a structural expansion joint.
 - 3. Tighten clamps to develop full friction along the pipeline except where loose fitting clamps are called for.
 - 4. Adjust hangers and supports to obtain required pipe slope and elevation. Shims made of material that is compatible with the piping material may be used. Adjust stanchions prior to grouting their baseplates.

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 5. Install supports for exhaust silencers and piping to maintain alignment and prevent stress on equipment connections. Ensure silencers are mounted with appropriate drainage and seismic restraint provisions. Adjust supports to accommodate thermal movement and vibration isolation.
- B. Electrolytic Protection: Pipe supports serving copper pipe or tubing shall be dielectrically insulated from the pipe by dielectric sleeves or plastic pipe wrap at the point of contact.

END OF SECTION

SECTION 15080

PIPING INSULATION

PART 1 - GENERAL

1.01 SUMMARY

- A. Provide insulation and accessories for piping systems and designated equipment.

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM) Standards:
 - 1. B209 Aluminum and Aluminum-Alloy Sheet and Plate
 - 2. C533 Calcium Silicate Block and Pipe Thermal Insulation
 - 3. C534 Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
 - 4. C547 Mineral Fiberglass Insulation.
 - 5. C552 Cellular Glass Thermal Insulation
 - 6. D1784 Standard Classification Systems and Basis for Specification for Rigid PVC Compounds and CPVC Compounds
 - 7. E84 Surface Burn Characteristics of Building Materials
 - 8. E96 Test for Water Vapor Transmission of Materials
- B. National Fire Protection Association (NFPA) Standards
- C. Underwriters' Laboratories, Inc. (UL) Publications:
 - 1. 723 Test Hazard Classification of Building Materials.

1.03 FIRE RESISTANCE

- A. Insulation. Smoke-developed ratings per NFPA 255, ASTM E 84 and UL 723 testing requirements to be as follows.
 - 1. Fiberglass with jacket not to exceed a flame-spread rating of 50.
- B. Tape, Adhesives, Vapor Barrier Materials, and Jackets. Flame-spread ratings not to exceed 25.
- C. Factory-Applied Items/Materials. Test these items as assembled. Provide Certificates of Compliance from an approved testing laboratory if not UL approved. Flame-proofing treatments which are subject to deterioration are not acceptable.
- D. Field-Applied Items/Materials. These items may be tested individually. Provide Certificates of Compliance from an approved testing laboratory if not UL approved; flame-proofing treatments which are subject to deterioration are not acceptable.
- E. Exempt Items/Materials. The following are exempt from the fire-resistance ratings:

1. Nylon duct insulation anchors.
2. Treated wood insulation inserts.
3. PVC fittings and valve covers.

1.04 THICKNESS

- A. Normal thickness of insulation is defined as the thickness of the basic insulating medium not including finishing coats.

1.05 APPROVED TESTING LABORATORIES

- A. Approved testing laboratories include:
1. Underwriters' Laboratories, Inc. (UL).
 2. Canadian Standards Association (CSA), where acceptable to local authorities.

1.06 EXPOSED VERSUS CONCEALED INSULATION

- A. Exposed is defined as Work exposed to the view of occupants in normally occupied areas and in equipment rooms.
- B. Concealed is defined as Work located in ceiling spaces, chases, and other locations not exposed to view.

1.07 SUBMITTALS

- A. Shop Drawings and Product Data: Submit the following as a single complete submittal in accordance with Section 01300:
1. Thermal insulation product data fully describing all items proposed for use to demonstrate that the equipment conforms to the Specifications.
- B. Affidavits: Submit affidavits from the manufacturer stating that the equipment has been properly installed, adjusted, and tested and is ready for full-time operation.

1.08 QUALITY ASSURANCE

- A. Qualifications: Materials and equipment furnished under this Section shall be supplied by a manufacturer who has been regularly engaged in the design and manufacture of the equipment for at least five years. Demonstrate to the satisfaction of the Engineer that the quality is equal to equipment made by those manufacturers named herein, if an alternate manufacturer is proposed.

PART 2 - PRODUCTS

2.01 THERMAL INSULATION FOR PLUMBING AND PIPING

- A. General:

1. Delivery: Deliver insulation materials to the job in original packages with manufacturer's "R" values clearly shown. Provide certification of compliance.
2. Warning: The Contractor is warned that working with fiberglass or rock wool materials may constitute a serious health hazard. The Contractor shall take all necessary precautions to ensure the safety of the workers.
3. Shields: Insulation protection shields are required *per paragraph 2.07c*.
4. The following table summarizes the insulation system by use and service:

System	Location	Service	Insulation System	Insulation Thickness (Inches)
<i>Engine Generator Exhaust</i>	<i>Engine Generator Building</i>	<i>E</i>	<i>D</i>	<i>3-inch</i>
<i>Refrigerant</i>	<i>Building Interior</i>	<i>E</i>	<i>E</i>	<i>Per Latest IECC</i>
<i>Refrigerant</i>	<i>Outdoors</i>	<i>E</i>	<i>E</i>	<i>Per Latest IECC</i>

For Service: E = Exposed including concealed space
 B = Buried

- B. Insulation System D: This system shall apply to all engine exhaust piping, exhaust silencer, emission control devices, and heat recovery unit.
 1. Insulation shall be a blanket-type system rated for 900 F continuous service (1200 F intermittent). Insulation shall include a Type 304 stainless steel inner liner asbestos-free fiberglass mat insulation. Insulation exterior shall be fiberglass impregnated cloth. Thermal Energy Products "Exhaust Wrap" or equal.
 2. Provide insulation over flexible connections. Fabricate insulation section as necessary to allow the full rated travel of the expansion joint.
- C. Insulation System E: Insulation shall be flexible elastomeric cellular material. Insulation shall have a "K" factor of not more than 0.28 at mean 100°F. Insulation shall be AP Armaflex or equal. Provide vapor barrier and a PVC, aluminum, or stainless-steel jacket.

PART 3 - EXECUTION

3.01 INSTALLATION OF INSULATION

- A. General: Apply insulation material, accessories, and finishes according to the manufacturer's printed instructions.

1. Apply insulation only after piping has been tested and certified as ready for operation, and after heat tracing elements have been installed where applicable.
 2. Seal joints and seams to maintain vapor barrier.
 3. Seal penetrations for hangers, supports, and anchors.
 4. Keep insulation material dry during application.
 5. Apply vapor barrier on seams, joints, over staples, and at end butt to fittings.
 6. Install with all joints tightly butted.
 7. Tuck and tuft all edges of insulation.
 8. Install insulation to allow easy access to piping or equipment for inspection and repairs.
 9. Carefully bevel and seal insulation around unit or equipment nameplates.
 10. Remove all loose dirt, rust, all other loose foreign material, moisture, and frost from surfaces prior to installing insulation.
 11. Seal all raw edges of insulation at unions, flanges, etc.
- B. Roof Penetrations: Apply insulation for interior applications to a point even with the top of the roof flashing. Seal with vapor barrier coating. Apply insulation for exterior applications butted tightly to interior insulation ends. Extend metal jacket for exterior insulation outside roof flashing at least 2 inches below top of roof flashing. Seal metal jacket to roof flashing with vapor barrier coating.
- C. Interior Walls and Partitions Penetration: Apply insulation continuously through walls and partitions, except fire-rated walls. Apply aluminum jacket with factory-applied moisture barrier over insulation. Extend 2 inches from both surfaces of wall or partition. Secure aluminum jacket with metal bands at both ends. Seal ends of jacket with vapor barrier coating. Seal around penetration with joint sealer.
- D. Whenever possible, slip insulation on pipe before making connections. Seal joints with adhesive. Where the slip-on technique is not possible, cut one side longitudinally and apply to the pipe. Seal seams and joints with adhesive.
- E. Cover exterior insulation, except for metal-jacketed insulation with PVC fitting covers and seal circumferential joints with butt strips. Paint all exterior PVC covering.
- F. Provide insulation protection shields at all pipe supports for insulated piping.

END OF SECTION

SECTION 15115

CHECK VALVES

PART 1 - GENERAL

1.01 SUMMARY

A. SECTION INCLUDES:

1. Swing check valves.

1.02 REFERENCES

- A. ASME B 16.1: Cast Iron Pipe Flanges and Flanged Fittings.
- B. ASTM A 126: Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
- C. AWWA C 508: Swing Check Valves for Waterworks Service, 2-24 inches NPS.
- D. AWWA C 550: Standard for Protective Interior Coatings for Valves and Hydrants.

1.03 SUBMITTALS

- A. Submit manufacturer's product data for valves, actuators, and accessories.
- B. Submit samples of gaskets and other materials where required by the detailed specifications.
- C. Submit certified test reports as required herein and by the referenced standard specifications (Product Information).
- D. Manuals: Furnish manufacturer's installation and operation manuals, bulletins, and spare parts lists for valves 4 inches and larger.
- E. Affidavits: Furnish affidavits from the manufacturers for the following:
- F. Submit manufacturer's affidavit for proposed valves and actuators certifying compliance with specifications

1.04 QUALITY ASSURANCE

- A. Materials and equipment furnished under this Section shall be of manufacturers who have been regularly engaged in the design and manufacture of the materials and equipment for a period of at least 5 years.

Demonstrate to the satisfaction of the Engineer that the quality is equal to the materials and equipment made by the manufacturers specifically named herein, if an alternate manufacturer is proposed.

- B. Factory Quality Control: The Contractor shall test all products as noted herein and by the reference specifications.

1.05 APPURTENCES

- A. Furnish and install all necessary guides, inserts, anchors and assembly bolts, washers and nuts, hangers, supports, gaskets, couplings and flanges; all other appurtenant items shown on the Drawings, specified or required for the proper installation and operation of the valve.

PART 2 - PRODUCTS

2.01 SWING CHECK VALVES

A. SWING CHECK VALVES 2-INCH THROUGH 12-INCH:

1. Rating: 250 psi maximum differential cold working pressure
2. Type: Swing, with rubber flapper, AWWA C508.
3. Provide exterior indicator of valve position.
4. Connections: Flanged, ASME 125/150
5. Materials:
 - a. Body, cover: Ductile iron, ASTM A536, Grade 65-45-12
 - b. Gasket: Non-asbestos with butadiene rubber binder
 - c. Cover bolts: 316 Stainless Steel
 - d. Body pipe plug: Iron, malleable ASTM A48, Class 40
 - e. Rubber flapper: reinforced NPB, acrylonitrile-butadiene, carbon steel ASTM A36
6. Manufacturers: APCO, CRF-100A Rubber Flapper Swing Check Valve or approved equal

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install check valves in accordance with manufacturers recommendations.

3.02 PROTECTIVE COATINGS

- A. Provide coating for all valves in accordance with Section 09960.

3.03 TESTING

- A. Test all valves to demonstrate operation.

END OF SECTION

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SECTION 15117

PLUG VALVES

PART 1 - GENERAL

1.01 SUMMARY

A. SECTION INCLUDES:

1. Eccentric Plug Valves.

1.02 REFERENCES

- A. ASME B 16.1: Cast Iron Pipe Flanges and Flanged Fittings.
- B. ASTM A 126: Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
- C. AWWA C517: Resilient-Seated Cast Iron Plug Valves
- D. AWWA C 550: Standard for Protective Interior Coatings for Valves and Hydrants.

1.03 SUBMITTALS

- A. Submit manufacturer's product data for valves, actuators, and accessories. Indicate maximum torque required to open valve, torque output of actuator, and number of turns to open valve.
- B. Submit samples of gaskets and other materials where required by the detailed specifications.
- C. Submit certified test reports as required herein and by the referenced standard specifications (Product Information).
- D. Manuals: Furnish manufacturer's installation and operation manuals, bulletins, and spare parts lists for valves 4 inches and larger.
- E. Affidavits: Furnish affidavits from the manufacturers for the following:
 1. Submit manufacturer's affidavit for proposed valves and actuators certifying compliance with specifications.

1.04 QUALITY ASSURANCE

- A. Materials and equipment furnished under this Section shall be of manufacturers who have been regularly engaged in the design and

manufacture of the materials and equipment for a period of at least 5 years. Demonstrate to the satisfaction of the Construction Manager that the quality is equal to the materials and equipment made by the manufacturers specifically named herein, if an alternate manufacturer is proposed.

- B. Factory Quality Control: The Contractor shall test all products as noted herein and by the reference specifications.

1.05 APPURTEANCES

- A. Furnish and install all necessary guides, inserts, anchors and assembly bolts, washers and nuts, hangers, supports, gaskets, couplings and flanges; all other appurtenant items shown on the Drawings, specified or required for the proper installation and operation of the valve.

PART 2 - PRODUCTS

2.01 ECCENTRIC PLUG VALVES

A. PLUG VALVES 2-INCH AND LARGER:

1. Rating: 175 psi through 12-inch.
2. Type: Resilient faced eccentric plug, lever operated 4-inch and smaller, worm geared handwheel operated 6-inch and larger. Valves shall provide driptight shutoff in both directions.
3. Connections: Flanged, 125-pound ANSI, except screwed connections may be used for 2-inch valves.
4. Materials: Cast iron body, welded nickel seat, NBR or Buna-N coated plug, NBR or Buna-N packing or U-cup stem seal. Valves shall have interior and exterior metal surfaces other than the plug and valve seat coated with two coats of high-solids epoxy with total dry film thickness 12 mils minimum.
5. Manufacturers: DeZurik PEC, Eccentric Plug Valve, or approved equal.
6. Installation: Unless otherwise necessary for proper installation or permitted by Engineer, all eccentric plug valves shall be installed with shaft horizontal and with plug in upper half of body. Valves in sewage lines shall be installed with seat on upstream end.

2.02 ACTUATORS

A. MANUAL ACTUATORS:

1. Type: Manual, except where specified otherwise, or shown otherwise on the Drawings. Provide valve position indicators on all actuators.
2. Manual Actuators:
 - a. Above-ground: Handwheel.
 - b. Below-ground: Manual nut with valve stem extension

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install eccentric plug valves in accordance with manufacturers recommendations.

3.02 PROTECTIVE COATINGS

- A. Provide coating for all valves in accordance with Section 09960.

3.03 TESTING

- A. Operationally test all valves to demonstrate operation without binding. Cycle valve three times minimum.
- B. Perform a leakage test for each valve. Test may occur in conjunction with pipeline test. Test in accordance with Section 15050.

END OF SECTION

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SECTION 15800

HEATING, VENTILATING AND AIR CONDITIONING

PART 1 - GENERAL

1.01 SECTION INCLUDES:

- A. Furnish all labor, materials, equipment, services, and incidentals required to provide complete, integrated, and operating, Heating, Ventilating, and Air Conditioning Systems for the buildings and structures in this project. Materials and equipment to be supplied shall be new, of the best quality as specified and as shown on the Drawings.
- B. WORK INCLUDED IN THIS SECTION:
 - 1. Ductwork
 - 2. Fans
 - 3. Ductless Split Systems
 - 4. Testing, Adjusting, and Balancing.

1.02 SUBMITTALS

- A. Provide shop drawings and technical literature covering all equipment and accessories being furnished under this Section and in accordance with Sections 01300 and 11001. The data shall include information to demonstrate compliance with all requirements of these Specifications.
- B. Submit signed and sealed structural calculations and detailed drawings for the attachments and anchorage to the structure of the equipment and appurtenances in this section: Calculations shall conform to the requirements of Section 01190.
- C. Manuals: Furnish manufacturer's installation, lubrication and maintenance manuals, bulletins, and parts lists. Furnish separate list of recommended spare parts.
- D. Affidavits: Furnish affidavits from the manufacturers stating that the equipment has been properly installed and tested and each is ready for full-time operation.
- E. Submit fabrication drawings for ductwork, including duct supports.

1.03 QUALITY ASSURANCE

- A. **Codes:** Comply with all rules and regulations of authorities having jurisdiction over the work specified herein.
- B. Permits and inspection shall be in accordance with General Conditions.
- C. All equipment furnished under this Section shall 1) be of a design and manufacturer who has been regularly engaged in the design and manufacture of the equipment; and 2) be demonstrated to the satisfaction of the Engineer that the quality is equal to equipment made by those manufacturers specifically named herein.
- D. The Drawings shall be taken in a sense as diagrammatic. Size of ducts and pipes including general method of running them are shown, but it is not intended to show every offset and fitting nor every structural difficulty that may be encountered.

1.04 WARRANTY

- A. The warranty for all products and work shall comply with the requirements of the Contractor's General Warranty and Guarantee described in the General Conditions and the Supplementary Conditions.

1.05 SEISMIC PROTECTION

- A. Equipment specified in this Section is classified as essential for seismic protection as specified in Division 1. Conform to the seismic requirements in Section 01190.

PART 2 - PRODUCTS

2.01 DUCTWORK

- A. **Flexible Duct Connections:** Flexible connections in ducts shall be made of neoprene fiberglass cloth, installed in folds, and of sufficient length to accommodate the maximum deflection resulting from vibration and contraction without causing strain. Minimum length in folded position shall be 4 inches. Flexible duct connections shall be Ventfabrics Inc. "Ventglas;" Duro-Dyne Corp.; "Neoprene;" or equal.
- B. **Rectangular Ductwork:** Ductwork shall be 304 stainless steel. Except as indicated otherwise, fabricate rectangular ducts of stainless sheet steel in accordance with SMACNA "HVAC Duct Construction Standards," Tables 1-3 through 1-19, including associated details. Conform to requirements of

referenced standard for metal thickness, reinforcing types and intervals, tie rod applications, and joint types and intervals.

1. Materials: Free from visual imperfections such as roller marks, seam marks, pitting, stains, and discolorations.
 2. Size ductwork as indicated on Drawings, coordinate with structure and other installations.
 3. Duct lengths: Appropriate to reinforcement and rigidity class required for pressure classification.
 4. Low pressure duct construction:
 - a. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees, convergence downstream shall not exceed 45 degrees.
 5. Rectangular duct transitions: Fabricate transitions in accordance with SMACNA "HVAC Duct Construction Standard," Figures 2-1 through 2-10.
- C. Duct sealant (for sealing joints) shall be Arabol and Canvas; Hardcast; or equal.

2.02 FANS

- A. Inline Centrifugal Fans: Inline centrifugal fans shall be factory fabricated assemblies having fan, fan motor, and fan housing. Fan capacities, electrical characteristics, special features and accessories shall be as indicated in the fan schedules on the Drawings. Where indicated, corrosion-resistant, factory applied coatings shall be Hi-Pro Polyester applied in strict conformance with the paint manufacturer's instructions. Fans shall bear the AMCA seal and shall be furnished with filter, automatic (gravity) backdraft dampers or motorized (electric motor operated) backdraft dampers, where indicated on the Drawings.
1. Housing: Square design, heavy gauge galvanized steel, equipped with square duct collars, two (2) removable access panels sized and arranged to permit easy access to all interior components, and universally adjustable mounting brackets for horizontal and vertical mounting. Provide fiberglass duct liner on interior of fan and motor housings.
 2. Fan Wheel: Constructed of aluminum, centrifugal backward inclined with wheel core, matched to inlet cone, statically and dynamically balanced.
 3. Direct Drive Fans: Provide fan wheel mounted on motor shaft.
 4. Motor: Permanently lubricated, compatible for use with speed controls, open type with motor cover.
 5. Disconnect Switch: Provide with each unit. Provide factory wiring from motor to junction box.

6. Remote Combination Motor Starter.
 7. Manufacturers: Centrifugal direct-drive exhaust fans shall be Greenheck Model SQ-90; Loren Cook Model SQND or equal.
- B. See Fan Schedule on the Drawings for specific requirements and accessories.

2.03 DUCTLESS SPLIT SYSTEM COOLING ONLY

- A. Ductless Split System Air Conditioner, Condensing Unit and Fan Coil: Systems shall be split, ductless systems. The indoor fan coil units shall be designed for mounting on the wall as indicated on the Drawings. The air conditioner and condensing unit shall be designed for outdoor, pad-mounted service. Refrigerant piping between the fan-coil unit and outdoor unit shall be as recommended by the manufacturer. Accessories shall include:
1. Integral condensate pump and fresh air intake kit shall be provided on the fan coil unit.
 2. Wired remote controller.
 3. Freeze-up, high discharge temperature, and self-diagnostics on the fan coil unit.
 4. High and low pressure safety switches, low voltage startup capability, and fluid line filter drier on the condenser unit. Refrigerant charge shall be Puron R 410A.
 5. Compressor shall be rotary inverter type hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
 6. Protective Coatings: The condensing unit coil, evaporator coil, and all exposed copper piping of the air handler and condensing units shall be coated with an epoxy-phenolic coating for use in a coastal environment, , or approved equal. Protective conformal shall be applied to all electrical/electronic printed circuitry and a severe duty interior chassis coating shall be applied on the condensing unit.
- B. MANUFACTURER:
1. FC-1/AC-1 shall consist of Mitsubishi TPKA0A0301KA70A wall unit with TRUZA0301HA70BA air conditioning; Toshiba Carrier; or equal.
 2. FC-2/AC-2 shall consist of Mitsubishi TPKA0A0301KA70A wall fan coil units with Mitsubishi TRUZA0301HA70BA air conditioning; Toshiba Carrier; or equal.
- C. See the Ductless Split System Heat Pump Schedule on the Drawings for specific requirements.

PART 3 - EXECUTION

3.01 GENERAL

- A. Protection: Fully protect all unfinished parts of the materials and equipment against damage from whatever cause during the progress of the work and until final completion. All materials and equipment shall be covered while in storage and during construction in such manner that no finished surfaces shall be damaged or marred, and all moving parts shall be kept perfectly clean and dry.
- B. Installation shall be in strict accordance with the best practice of the several trades and with the respective manufacturer's instructions and recommendations. Installation shall include furnishing the required oil and grease for initial operation in accordance with the manufacturer's instructions.
- C. All sheet metal ductwork shall be erected in a first class and workmanlike manner and shall be in accordance with the SMACNA "HVAC Duct Construction Standards" and as specified above. No ductwork shall be fabricated or installed until it has been carefully coordinated with other trades. All transverse duct joints shall be taped airtight. Duct dimensions shown are "net" inside clear. Each air supply outlet and each air return or outside air intake shall have either an integral volume control device or shall be furnished with a volume damper.
- D. TESTING AND ADJUSTING EQUIPMENT AND CONTROLS:
 1. The equipment and controls of this Section shall be completely tested, adjusted, and placed in operating condition.
 2. Retest equipment and controls, as necessary, during the progress of the work. No work shall be covered until it is properly tested and made tight.
 3. Supply the testing apparatus and make all necessary connections for applying the tests.
 4. When about to turn the apparatus over to the City, put all parts of the apparatus in perfect working order and thoroughly clean out all parts of the equipment.
- E. TESTING, ADJUSTING AND BALANCING OF HEATING, VENTILATING AND AIR CONDITIONING SYSTEMS:
 1. All heating, ventilating, and air conditioning systems installed under this Section shall be carefully adjusted by a qualified Air Balancing Contractor to deliver and exhaust air quantities as shown on the Drawings or described herein while maintaining the spaces served at the design temperature. A final balancing report shall be submitted to

- the Engineer showing the air flow CFMs, fan statics, and motor amperages.
2. After the systems have been completely installed, all equipment shall be carefully tested and adjusted. Adjust all dampers, registers, and air diffusers for air flow and make an accurate velometer test of air quantities delivered and removed from each opening. Any readjustments in the motors, drives, units, controls, and other equipment found to be necessary in the opinion of the Engineer shall be made without additional cost and the entire system shall be placed in a satisfactory operating condition subject to the approval of the Engineer.
 3. Air readings must be taken at each inlet and outlet, and fan speeds and dampers regulated until proper air volumes and diffusion are obtained at each inlet and outlet. Amperage and voltage readings shall be taken and noted, together with the nameplate amperage on the motors.

3.02 HVAC CONTROL DESCRIPTIONS

A. Electrical Room:

1. Ductless split system air conditioning outdoor units AC-1 and AC-2 and fan coils FC-1 and FC-2 are controlled through their dedicated wired system controller/programmable thermostat and shall operate to maintain the cooling temperature setpoints shown on the Drawings.

B. Generator Room:

1. The room shall be ventilated by exhaust fan EF-1. EF-1 shall be equipped with an ON/OFF hand switch. The fan shall run continuously in the ON position and shall be turned off in the OFF position.

END OF SECTION

SECTION 16010

GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Work Included:

1. Provide all required labor, project equipment and materials, tools, construction equipment, safety equipment, transportation, and test equipment, and satisfactorily complete all electrical work shown on the Drawings, included in these Specifications, or required for a complete and fully operating facility. In addition, provide wiring for the equipment that will be provided under other Divisions of these Specifications.
2. Provide all conduit for the Instrumentation and Controls specified in Division 17. Provide all Instrumentation and Control wire that is specified in Division 16. All other necessary Instrumentation and Controls wire shall be provided under Division 17. See Section 17010.
3. Auxiliary Devices: Provide conduit and wire for power and control for all auxiliary devices such as solenoid valves, pressure switches, and instruments that are included as part of a manufacturer's packaged system (i.e., all systems specified in Divisions 11 through 15). Contractor shall be responsible for conduit and wire to these auxiliary devices even if not specifically shown on the Drawings or specified herein.

B. Work Specified in Other Divisions:

1. Section 11002: Electric Motor Drives - providing electric motors
2. Division 17: Providing instruments and other equipment as specified in Division 17.

C. Work to be Done by Others:

1. Programming and testing of SCADA RTU.

D. Safety: Conduct operations in accordance with NFPA 70E, Standard for Electrical Safety Requirements for Employee Workspaces.

1.02 SUBMITTALS

A. Shop Drawings:

1. General: Submit Product Review or Product information shop drawings for materials and equipment as required under each Specification section.
2. For Product Review submittals, submit a single, complete submittal package for all equipment specified under Division 16. The submittal

- package shall be organized by Specification section. Include separators and tabs or other means of identifying each section of the submittal.
- B. As-Built Shop Drawings: Revise manufacturer's shop drawings to show any construction changes. Prior to final acceptance, deliver one complete set to the Officer-in-Charge for his favorable review. After such review, provide copies of all CAD produced drawings on magnetic media satisfactory to the Officer-in-Charge in AutoCAD DWG format.
 - C. Manuals:
 - 1. Furnish manuals for equipment where Manuals are specified in the equipment Specifications. Submit manuals in accordance with the requirements of Division 1.
 - 2. In each manual, include equipment descriptions, record shop drawings, operation and maintenance instructions, parts ordering data and ratings for the equipment furnished for this project.
 - D. Spare Parts: For each piece of equipment, submit a list of recommended spare parts. Include part numbers and the name, address, and telephone number of the supplier.

1.03 QUALITY ASSURANCE

- A. Codes: All electrical equipment and materials, including installation and testing, shall conform to the following applicable codes:
 - 1. National Electrical Code (NEC), current edition;
 - 2. National Electrical Safety Code (NESC), current edition;
 - 3. Occupational Safety and Health Act (OSHA) standards;
 - 4. Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems, International Electrical Testing Association (NETA).
- B. Variances: In instances where two or more codes are at variance, the most restrictive requirements shall apply.
- C. Standards: Equipment shall conform to applicable standards of American National Standards Institute (ANSI), Electronics Industries Association (EIA), Institute of Electrical and Electronics Engineers (IEEE), and National Electrical Manufacturers Association (NEMA). The revisions of these standards in effect on the date of issuance of the Contract Documents shall apply.
- D. Underwriters Laboratories, Inc. (UL) listing is required for all equipment and materials where such listing is offered by the Underwriters Laboratories. Safety labeling and listing by other organizations, such as ETL Testing Laboratories, may be substituted for UL labeling and listing if acceptable to

the authority having code enforcement jurisdiction. Provide service entrance labels for all equipment required by the NEC to have such labels.

- E. Contractor's Expense: Obtain and pay for all required bonds, insurance, licenses, permits and inspections, and pay all taxes, fees and utility charges that will be required for the electrical construction work.
- F. Series short circuit ratings for protective devices are not allowed.
- G. Contractor shall have five recent project experiences in hazardous wastewater environment.

1.04 DRAWINGS

- A. Drawings: The Electrical Drawings are diagrammatic; exact locations of electrical products shall be verified in the field with the Officer-in-Charge. Except where special details are used to illustrate the method of installation of a particular piece or type of equipment or material, the requirements or descriptions in this Specification shall take precedence in the event of conflict.
 - 1. Locations of equipment, inserts, anchors, motors, panels, pull boxes, manholes, conduits, stub-ups, fittings, lighting fixtures, power and convenience outlets, exterior lighting units and ground wells are approximate unless dimensioned; verify locations with the Officer-in-Charge prior to installation.
Field verify scaled dimensions on Drawings.
 - 2. Review the Drawings and Specification Divisions of other trades and perform the electrical work that will be required for the installations.
 - 3. Should there be a need to deviate from the Electrical Drawings and Specifications, submit written details and reasons for all changes to the Officer-in-Charge for favorable review.
 - 4. Resolution of conflicting interpretations of the Contract Documents shall conform to General Conditions Section 3.14.
- B. As-Built Drawings:
 - 1. Maintain a complete and accurate record set of Drawings for the electrical construction work.
 - 2. Record all work that is installed differently than shown on the Drawings.
 - 3. Upon completion of the work, transfer all marked changes to a clean set of full-size Drawings with red ink. Mark the Drawings "AS-BUILT DRAWINGS" and submit them to the Officer-in-Charge when the electrical work is completed.
 - 4. Locate all underground conduits by accurate field-measured dimensions from walls and corners, etc., of surrounding structures.

1.05 FACTORY TESTS

- A. Submit reports of factory tests and adjustments performed by equipment manufacturers to the Officer-in-Charge prior to field testing and adjustment of the equipment. These reports shall identify the equipment and show dates, results of tests, measured values and final adjustment settings. Provide factory tests and adjustments for equipment where factory tests are specified in the equipment Specifications.

1.06 INSPECTIONS

- A. The Officer-in-Charge may inspect the fabricated equipment at the factory before shipment to job site. Provide the Officer-in-Charge with sufficient prior notice so that an inspection can be arranged at the factory.
- B. Inspection of the equipment at the factory by the Officer-in-Charge will be made after the manufacturer has performed satisfactory checks, adjustments, tests and operations.
- C. Favorable review of the equipment at the factory only allows the manufacturer to ship the equipment to the project site. The Contractor shall be responsible for the proper installation and satisfactory startup operation of the equipment to the satisfaction of the manufacturer and the Officer-in-Charge.

1.07 COORDINATION

- A. Coordinate the electrical work with the other trades, code authorities, utilities, and the Officer-in-Charge.
- B. Where connections must be made to existing installations, properly schedule all the required work, including the power shutdown periods. Schedule and carry out shutdowns so as to cause the least disruption to operation of the plant and privately owned facilities.
- C. When two trades join together in an area, make certain that no electrical work is omitted.

1.08 JOB CONDITIONS

- A. Operations:
 1. Keep all power shutdown periods to a minimum.
 2. Carry out shutdowns only after the schedule has been favorably reviewed by the Officer-in-Charge.
- B. Construction Power:

1. Make all arrangements for the required construction power.
 2. When required, provide all equipment, materials and wiring in accordance with the applicable codes and regulations.
 3. Upon completion of the project, remove all temporary construction power equipment, material and wiring from the site as the property of the Contractor.
- C. Storage: Provide adequate storage for all equipment and materials which will become part of the completed facility so that it is protected from weather, dust, water, or construction operations.

1.09 DAMAGED PRODUCTS

- A. Notify the Officer-in-Charge in writing in the event that any equipment or material is damaged.
- B. Obtain prior favorable review by the Officer-in-Charge before making repairs to damaged products.

1.10 OPTIONAL EQUIPMENT

- A. For optional or substituted equipment, refer to Division 1,

1.11 LOCATIONS

- A. General: Use equipment, materials and wiring methods suitable for the types of locations in which they are located, as defined in Paragraph B. herein.
- B. Definitions of Types of Locations:
 1. Dry Locations: All those indoor areas which do not fall within the definitions below for Wet, Damp, Hazardous, or Corrosive Locations and which are not otherwise designated on the Drawings.
 2. Wet Locations: All locations exposed to the weather, whether under a roof or not, unless otherwise designated on the Drawings.
 3. 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 Drawings.
 4. Hazardous Locations: All areas in which fire or explosion hazards may exist, normally or accidentally, due to flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers or flyings. These areas are shown on the Drawings, together with the Class and Division designations as defined in the NEC, determining the enclosure types and wiring methods required.
 5. Corrosive Locations: Areas where chlorine or sulfur dioxide gas under pressure, sulfuric acid, or liquid polymer are stored or processed. These areas are shown on the Drawings.

PART 2 - PRODUCTS

2.01 STANDARD OF QUALITY

- A. Products that are specified by manufacturer, trade name or catalog number establish a standard of quality and do not prohibit the use of equal products of other manufacturers provided they are favorably reviewed by the Officer-in-Charge prior to installation.
- B. It is the intent of these Specifications and Drawings to secure high quality in all materials and equipment in order to facilitate operation and maintenance of the facility. All equipment and materials shall be new and the products of reputable suppliers having adequate experience in the manufacture of these particular items. For uniformity, only one manufacturer will be accepted for each type of product. All equipment shall be designed for the service intended and shall be of rugged construction, of ample strength for all stresses, which may occur during fabrication, transportation, erection, and continuous or intermittent operation. All equipment shall be adequately stayed, braced and anchored and shall be installed in a neat and workmanlike manner. Appearance and safety, as well as utility, shall be given consideration in the design of details.
- C. All components and devices installed shall be standard items of industrial grade, unless otherwise noted, and shall be of sturdy and durable construction suitable for long, trouble-free service. Light-duty, fragile and competitive grade devices of doubtful durability shall not be used.

2.02 NAMEPLATES

- A. For each piece of electrical equipment, provide a manufacturer's nameplate showing his name, location, the pertinent ratings and the model designation.
- B. Identify each piece of equipment and related controls with a rigid laminated engraved phenolic nameplate. Engrave nameplates with the inscriptions indicated on the Drawings and, if not so indicated, with the equipment name. Securely fasten nameplates in place using two stainless steel screws or, where favorably reviewed by the Officer-in-Charge, with epoxy cement. Where no inscription is indicated on the Drawings, furnish nameplates with an appropriate inscription furnished by the Officer-in-Charge upon prior request by the Contractor.
- C. Each control device, including pushbuttons, control switches, and indicating lights, shall have an integral legend plate or nameplate indicating the device function. These shall be inscribed as indicated on the Drawings or as favorably reviewed by the Officer-in-Charge.

2.03 FASTENERS

- A. 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 3/8 inch.

2.04 PAINTING

- A. Equipment: Refer to each electrical equipment section of these Specifications for painting requirements of equipment enclosures. Repair any final paint finish, which has been damaged or is otherwise unsatisfactory, to the satisfaction of the Officer-in-Charge.
- B. Wiring System: Paint all exposed conduits, boxes and fittings orange to match the standard color of electrical equipment at Waianae WWTP. Paint finishes shall include proper surface preparation, prime coat and a final finish coat, and shall conform to Section 09960.

2.05 ENCLOSURES

- A. Unless otherwise noted, provide enclosures as follows:
 1. Dry Locations: NEMA Type 1
 2. Wet Locations: NEMA Type 4
 3. Damp Locations: NEMA Type 12
 4. Hazardous Locations (gases): NEMA Type 7
 5. Hazardous Locations (dusts): NEMA Type 9
 6. Corrosive Locations: NEMA Type 4X 316 Stainless Steel
 7. See additional requirements below in Paragraph 3.08, Metal Panels.

PART 3 - EXECUTION

3.01 REQUIREMENTS

- A. All electrical installations shall conform to the codes and standards outlined in this Section.

3.02 WORKMANSHIP

- A. Assign a qualified representative who shall supervise the electrical construction work from beginning to completion and final acceptance.

- B. Perform all labor using qualified craftsmen, who have had experience on similar projects. Provide first-class workmanship for all installations.
- C. Ensure that all equipment and materials fit properly in their installations.
- D. Perform any required work to correct improperly fit installations at no additional expense to the City.

3.03 EXCAVATION AND BACKFILL

- A. Provide the excavations for electrical equipment foundations and trenches for conduits as shown on the Drawings.
- B. Exercise caution during all excavation work and avoid damage to existing underground pipes. Exercise extreme caution when working near existing electrical conduits and facilities. Field verify the location of all electrical facilities before proceeding with any nearby work.
- C. Refer to Division 2, Earthwork, of these Specifications for all excavation and backfilling work.

3.04 CONCRETE

- A. Where shown on the Drawings or specified, provide the required concrete installations for conduit encasement and equipment foundations.
- B. Refer to Division 3, Concrete, of these Specifications for all concrete work.

3.05 CONDUCTOR IDENTIFICATION

- A. Identify all wires and cables in conformance with the requirements of Sections 16120 and 16124. This requirement applies to all equipment provided under this contract, regardless of Division, as well as to all conductors provided or worked on during this contract.

3.06 INSTALLING EQUIPMENT

- A. Provide the required inserts, bolts and anchors, and securely attach all equipment and materials to their supports.
- B. Install all floor-mounted equipment on 3-inch-high reinforced concrete pads. The Contractor, suppliers, and fabricators shall take this requirement into consideration when designing, fabricating, and installing panels, motor control centers, and other enclosures so that height above the floor of the operating handles of electrical devices meets the requirements of these Specifications and applicable codes.

3.07 CUTTING, DRILLING, AND WELDING

- A. Provide any cutting, drilling, and welding that is required for the electrical construction work.
- B. Structural members shall not be cut or drilled, except when favorably reviewed by the Officer-in-Charge. Use a core drill wherever it is necessary to drill through concrete or masonry.
- C. Provide the required welding for equipment supports. Conduits and fittings shall not be welded to structural steel.
- D. Perform patch work with the same materials as the surrounding area and finish to match, as specified in Division 3 of these Specifications.

3.08 METAL PANELS

- A. Mount all metal panels which are mounted on or abutting concrete walls in damp locations or any outside walls $\frac{1}{4}$ inch from the wall, and paint the back sides of the panels with a high build epoxy primer. Film thickness shall be 10 mils minimum.

3.09 ARC FLASH ANALYSIS & PROTECTIVE DEVICE COORDINATION

- A. Protective Device Coordination:
 1. Perform a protective device coordination study for the new plant and related existing electrical equipment.
 2. Provide the services of a recognized independent testing laboratory or coordination analysis consultant for the proper system coordination of the protective devices furnished on this project. Submit the name and the qualifications of the laboratory or consultant for review by the Officer-in-Charge; qualifications must include professional registration of proposed personnel as electrical engineers.
 3. The protective device on the line side closest to the fault or abnormal conditions shall isolate the problem portion of the system and minimize damage in that portion. The rest of the system shall be maintained in normal service. The coordination shall be in conformance with the recommendations of latest IEEE Standard 242.
 4. Submit the analysis that shall include impedance and short circuit calculations, list of any assumptions made in the analysis, the recommended settings of the protective devices, and the system time/current characteristic curves. The submittal shall be made so as to allow time for review and resubmittal, if necessary, before the implementation of final settings and adjustments by the testing laboratory.

B. Arc Flash Analysis

1. Perform an arc flash hazard study for the new plant and related existing electrical equipment.
2. Perform study after the protective device coordination study has been completed. Apply the IEEE 1584 nine step analysis procedure.
3. For each major part of the electrical power system, determine the following:
 - a. Flash hazard protection boundary.
 - b. Limited approach boundary.
 - c. Restricted approach boundary.
 - d. Prohibited approach boundary.
 - e. Incident energy level.
 - f. PPE hazard/risk category.
 - g. Type of PPE required.
4. Produce arc flash warning labels listing items 3 a-g from above. Also include the bus name and voltage.
5. Produce bus detail sheets that list the items 3 a-g from above and the following additional items.
 - a. Bus name.
 - b. Upstream protective device name, type, and settings.
 - c. Bus line to line voltage.
6. Provide arc flash warning labels printed in color on adhesive backed labels. Provide weatherproof labels for equipment installed outdoors, or for equipment installed in locations that are in NEMA 3R, NEMA 4/4X or NEMA 12 locations.

C. The Testing Firm shall work with the Contractor and the Study Firm for implementing the Arc Flash Hazard sign installation for electrical equipment as specified in NEC Article 110.16 Flash Protection and NFPA 70E.

3.10 FIELD TESTS

- A. Perform tests in accordance with applicable procedures as described in NETA Acceptance Testing Specifications.
- B. Give sufficient notice to the Officer-in-Charge prior to any test to permit witnessing the test.
- C. Provide the services of a recognized independent testing laboratory and pay all costs of performing the inspections and tests as specified herein.
- D. The testing laboratory shall provide all materials, equipment, labor and technical supervision to perform such tests and inspections. It is the intent of these tests to ensure that all electrical equipment is operational within industry and manufacturer's tolerances and is installed in accordance with

the Contract Documents and manufacturer's instructions. The tests and inspections shall determine the suitability for energization.

- E. The testing laboratory shall meet federal OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907. Membership in the International Electrical Testing Association (NETA) constitutes proof of meeting such criteria. The testing laboratory shall submit proof of these qualifications to the Officer-in-Charge for review. Testing laboratory shall be Electrical Testing and Controls, Electro-Test, Power Systems, or approved substitute.
- F. The testing laboratory shall have a calibration program, which maintains all applicable test instrumentation within, rated accuracy. The accuracy shall be traceable to the National Bureau of Standards in an unbroken chain. Instruments shall be calibrated in accordance with the following frequency schedule:
 - 1. Field instruments: 6 months maximum
 - 2. Laboratory instruments: 12 months
 - 3. Leased specialty equipment: 12 monthsDate calibration labels shall be visible on all test equipment.
- G. Where testing pursuant to NETA requirements is required in these specifications, submit a test report which includes the following:
 - 1. Name of project, name of person performing test, and date of test
 - 2. Description of equipment tested
 - 3. Description of test
 - 4. List of test equipment used and calibration date
 - 5. Test results
 - 6. Conclusions and recommendations
 - 7. Appendix, including appropriate test formsThe test report shall be bound and its contents certified. Submit the completed report directly to the Officer-in-Charge no later than thirty (30) days after completion of the test unless directed otherwise. Number of reports to be submitted for review shall be the same as the number required for shop drawing submittals.
- H. Safety practices shall include, but are not limited to, the following requirements:
 - 1. Occupational Safety and Health Act, OSHA.
 - 2. Accident Prevention Manual for Industrial Operations, Seventh Edition, National Safety Council, Chapter 4.
 - 3. Applicable state and local safety operating procedures.
- I. All field tests shall be performed with apparatus de-energized except where otherwise specifically required by Section 7 of the latest Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems

published by NETA. The testing laboratory shall have a designated safety representative who shall be present on the project and supervise operations with respect to safety. Circuits operating in excess of 600 volts between conductors shall have conductors shorted to ground by a hot-line grounded device approved for the purpose. In all cases, work shall not proceed until the safety representative has determined that it is safe to do so. The testing laboratory shall have available sufficient protective barriers and warning signs to conduct specified test safely.

- J. Electrical equipment and materials furnished and installed by the Contractor, and the testing equipment listed below shall be tested in accordance with the "Inspection and Test Procedures" and "System Function Tests" (Section 7) of the latest Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems published by NETA. Tests shall not include any tests listed as optional in the aforementioned NETA Specifications unless specifically noted in respective equipment specifications for this project.
- K. Retesting will be required for all unsatisfactory tests after the equipment or system has been repaired. Retest all related equipment and systems if required by the Officer-in-Charge. Repair and retest equipment and systems, which have been satisfactorily tested but later, fail, until satisfactory performance is obtained.
- L. Putting Equipment and Cables into Service: Submittal and favorable review of the specified factory and field tests shall occur before the Contractor is permitted to place the respective equipment or cable into service.

M. Miscellaneous Tests

- 1. Insulation Resistance, Continuity, Rotation: Perform routine insulation resistance, continuity and rotation tests for all distribution and utilization equipment including all motors 1/2 horsepower and larger prior and in addition to tests performed by the testing laboratory specified herein. Supply a suitable and stable source of test power to the test laboratory at each test site. The testing laboratory shall specify requirements. Notify the testing laboratory when equipment becomes available for acceptance tests. Work shall be coordinated to expedite project scheduling. All testing shall be performed in the presence of the Officer-in-Charge. The testing laboratory shall be responsible for implementing all final settings and adjustments on protective devices and tap changes. Any system material or workmanship that is found defective on the basis of acceptance tests shall be reported directly to the Officer-in-Charge. The testing laboratory shall maintain a written record of all tests and upon completion of project, assemble and certify a final test report.
- 2. Motor Current: Measure and record current in each phase for each new motor. Include measurement of the motor terminal voltages and motor currents when the motor is being operated at normal operating loads. For

- motors that are part of variable frequency drive systems, use true-RMS-reading instruments in making the measurements.
3. Operational Tests: Operationally 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, including alarm conditions, and demonstrate satisfactory interfacing with the data acquisition and alarm systems.

3.11 EQUIPMENT PROTECTION

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

3.12 CLEANING EQUIPMENT

- A. Thoroughly clean all soiled surfaces of installed equipment and materials.
- B. Clean out and vacuum all construction debris from the bottom of all equipment.
- C. Provide and touch-up to original condition any factory painting that has been marred or scratched during shipment or installation, using paint furnished by the equipment manufacturer.

3.13 CLEANUP

- A. 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 Officer-in-Charge.

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SECTION 16110

CONDUIT, RACEWAYS, AND FITTINGS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Provisions: Applicable provisions of Section 16010 become a part of this Section as if repeated herein.
- B. Work specified in other Divisions:
 - 1. Division 2: Excavation and Backfill of Trenches
 - 2. Division 3: Concrete Emplacement

1.02 REFERENCE STANDARDS

- A. American National Standards Institute (ANSI) Publications:
 - 1. C80.1 Specification for Zinc Coated Rigid Steel Conduit
 - 2. C80.3 Specifications for Zinc Coated Electrical Metallic Tubing
- B. Federal Specifications (FS):
 - 1. FS W-C-1094 W-C-1094A Conduit and Conduit Fittings, Plastic, Rigid
- C. National Electrical Manufacturers Association (NEMA) Publications:
 - 1. RN 1 Polyvinyl Chloride Externally Coated Galvanized Rigid Steel Conduit
 - 2. TC 6 PVC and ABS Plastic Utilities Duct for Underground Installation
 - 3. TC 14 Filament-Wound Reinforced Thermosetting Resin Conduit
- D. Underwriters Laboratories, Inc. (UL) Standards:
 - 1. 6 Rigid Metal Electrical Conduit
 - 2. 360 Liquid-Tight Flexible Steel Electrical Conduit
 - 3. 651 Electrical Rigid Nonmetallic Conduit

1.03 SUBMITTALS

- A. Submit material or equipment data in accordance with the General Conditions Section 5 and the submittal requirements of Section 16010.

1.04 LOCATIONS

- A. Refer to Section 16010 for definitions of types of locations.

PART 2 - PRODUCTS

2.01 CONDUIT, RACEWAYS

- A. General:
 - 1. Type 316 stainless steel conduit shall be used in all conduit systems, except where otherwise shown on the Drawings, where flexible conduit is required, or where these Specifications require, or allow the use of polyvinyl chloride (PVC) conduit.
 - 2. The minimum size raceway shall be $\frac{3}{4}$ inch unless indicated otherwise on the Drawings.
- B. Galvanized Rigid Steel Conduit (GRS) shall be hot-dip galvanized after fabrication, conforming to ANSI C80.1 and UL 6. Couplings shall be threaded type. Where PVC coated rigid steel conduit is called for, it shall be hot-dip galvanized, conforming to NEMA RN 1, with factory-applied PVC coating 40 mils thick.
- C. Flexible Conduit:
 - 1. Flexible metal conduit shall be liquid-tight, shall have a moisture- and oil-proof PVC jacket extruded over a galvanized, flexible steel conduit, and shall conform to UL 360.
 - 2. Flexible conduit for hazardous locations shall be UL listed for the applicable Class, Division, and Group.
- D. Rigid Nonmetallic Conduit: Rigid nonmetallic conduit shall be PVC Schedule 40 (PVC-40) conduit approved for underground use and for use with 90°C wires, and shall conform to UL 651.
- E. Electrical Nonmetallic Tubing (ENMT): Shall be UL listed rigid, hand bendable, corrugated non-metallic PVC tubing meeting NFPA 70 (NEC) Article 331 requirements.

2.02 CONDUIT SUPPORTS

- A. Supports for individual conduits shall be Type 316 stainless steel, one-hole type with conduit back spacer.
- B. Supports for multiple conduits shall be Type 316 stainless steel Unistrut or Superstrut channels, or approved substitute. All associated hardware shall be Type 316 stainless steel.

2.03 FITTINGS

- A. Fittings for use with RMC shall be hot dipped galvanized steel or galvanized cast ferrous metal; access fittings shall have gasketed cast covers and be

- Crouse-Hinds Condulets; Appleton Unilets; or approved substitute. Provide threaded-type couplings and connectors; set-screw type and compression-type are not acceptable.
- B. Fittings for use with either rigid nonmetallic conduit or duct shall be PVC and have solvent-weld-type conduit connections. If such are not available, then the Specification for PVC coated galvanized rigid steel fittings shall apply.
 - C. Fittings for flexible conduit shall be Appleton Type ST; O-Z Gedney Series 4Q; or approved substitute.
 - D. Union couplings for conduits shall be the Erickson type and shall be Appleton Type EC; O-Z Gedney 3-piece Series 4; or approved substitute. Threadless couplings shall not be used.
 - E. Bushings:
 - 1. Bushings shall be the insulated type.
 - 2. Bushings for rigid steel shall be hot dip galvanized insulated grounding type, O-Z Gedney Type HBLG; Appleton Type GIB; or approved substitute.
 - F. Conduit seals shall have zinc electroplate and shall be Crouse-Hinds Type EYS or EZS; Appleton Type EYS, ESU, or EY series; or approved substitute.
 - G. Fittings for ENMT shall be snap on-snap in types specially fabricated for ENMT.

2.04 WIREWAYS AND AUXILIARY GUTTERS

- A. General: Wireways shall consist of a prefabricated channel-shaped trough with hinged or removable covers, associated fittings, and supports. Straight sections shall not be longer than 5 feet. Cross-sectional dimensions shall be as indicated on the Drawings. Fittings shall consist of elbows, tees, crosses, and closing plates as required.
- B. Interior Locations: All components shall be constructed from sheet steel not less than 16 gauge and coated with a corrosion-resistant gray paint. Covers shall be held closed with screws.
- C. Exterior Locations: Wireway and associated fittings shall meet NEMA 4X Type 316 stainless steel classifications, with gasketed closing end plates and gasketed hinged covers.
- D. Corrosive Locations: In corrosive locations provide enclosure type boxes for use as wireways. Enclosures and associated fittings shall meet NEMA 4X

Type 316 stainless steel classifications and shall be manufactured from reinforced injection molded fiberglass or formed and welded stainless steel, and shall have gasketed closing plates and hinged and gasketed covers with spring loaded latches.

- E. Explosive Locations: Wireway and associated fittings shall meet NEMA 7 classifications.

2.05 SURFACE RACEWAYS

- A. Surface metal raceways shall conform to the requirements of ANSI/NFPA 70 (the NEC) Article 352. Minimum cross-sectional area shall equal or exceed that of 3/4-inch conduit.

2.06 CONDUIT SEALANTS

- A. 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.
- B. 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.

2.07 WARNING TAPE

- A. Provide electrical warning tape in duct bank as shown on the Drawings. The tape shall be 6 inches wide, red with black lettering stating "CAUTION BURIED ELECTRIC LINE." The tape shall be made of 6-mil polymer with 36,000 psi tensile strength.

PART 3 - EXECUTION

3.01 CONDUIT, RACEWAY, AND FITTING INSTALLATION

- A. From pull point to pull point, the sum of the angles of all of the bends and offsets shall not exceed 270 degrees.
- B. For power, control and signal circuits, provide conduit per Conduit Use Tables below, unless specifically indicated otherwise on the Drawings:
 1. Exception: For raceways leaving a building above grade and then going below grade, provide Type 316 stainless steel from a point 3 feet above grade to a point 5 feet from the building wall.

- C. At all boxes and equipment, provide insulated type metallic grounding bushings for metallic conduits. Bond together all conduits to provide continuity of the equipment grounding system. Size bonding conductor per code.
- D. Provide flexible conduit in lengths of not more than 36 inches unless approved by the Officer-in-Charge at connections to motors, valves and any equipment subject to vibration or relative movement.
- E. Conduits embedded in concrete floors on grade shall be installed between grids of reinforcing steel, or shall be encased below the floors, provided the concrete is thickened in a manner satisfactory to the Officer-in-Charge. Installation of conduit below the bottom of this slab is not acceptable; embedding or encasing is required.
- F. Provide galvanized rigid steel factory ells for RMC raceways. Provide RMC for offsets in RMC raceways.
- G. Install fiberglass conduit in accordance with the manufacturer's instructions. Connections between sections of conduit may be either glued or threaded, at the Contractor's option.
- H. Underground Raceways: Slope all underground raceways to provide drainage; for example, slope conduit from equipment located inside a building to the handhole located outside the building. For additional requirements see Section 16402.
- I. Conduit Supports: Properly support all conduits as required by the NEC. Run all conduits exposed except where the Drawings indicate that they are to be embedded in the floor slab, walls, or ceiling, or to be installed underground.
 - 1. Exposed Conduits:
 - a. Support exposed conduits within 1 foot of any outlet and at intervals not exceeding NEC requirements; wherever possible, group conduits together and support on common supports. Support exposed conduits fastened to the surface of the concrete structure by one-hole clamps, or with channels. Use conduit spacers with one-hole clamps. Coordinate conduit locations with piping, equipment, fixtures, and with structural and architectural elements. Conduits attached to walls or columns shall be as unobtrusive as possible and shall avoid windows. Run all exposed conduits parallel to building lines.
 - b. Group together exposed conduits in horizontal runs located away from walls and support on trapeze hangers. Arrange such conduits uniformly and neatly. Trapeze hangers shall consist of channels of adequate size, suspended by means of rods or other suitable means from the ceiling or from pipe hangers. Install such runs so as not to

- interfere with the operation of valves or any other equipment, and keep at least 6 inches clear of any pipe, which may operate at more than 100°F. Treat cut surfaces or damaged ends with corrosion-resistant coatings such as "Devcon Z", prepared by Subox Coatings; "Galvanox Type I", prepared by Pedley-Knowles; or approved substitute. Application shall follow manufacturer's recommendation.
2. Conduits Embedded in Concrete: Provide concrete cover at least equal to that of the reinforcing steel, space at 3 conduit diameters apart except where they cross at angles greater than 45 degrees, and install so as not to reduce the structural integrity of the concrete element.
- J. When expansion joints are crossed, whether conduit is embedded or exposed, provide watertight expansion fittings and bonding jumpers. In hazardous locations, provide Crouse-Hinds UNF/UNV, Appleton, or approved substitute. In unclassified locations, provide Crouse-Hinds XD, Appleton, or approved substitute.
- K. Spare Raceways: After completing a conduit run between manholes, handholes, or pull boxes, prove the integrity of the conduit run. Use an air compressor to blow in a pull-line, then use the pull-line to pull a mandrel through the entire conduit run. Install a new 3/16-inch nylon, 800 pound test pull-line which has tape measure marking every foot to indicate length. Plug the ends of the conduit, with conduit cap plugs.
- L. All penetrations through walls into or out of corrosive locations, as defined in Section 16010 shall be made gas-tight. In concrete walls, pour concrete after the conduit is in place, if possible. If not, core drill concrete or CMU walls, install conduit and caulk around it with non-shrink grout. Install conduit seal in each conduit near the penetration.
- M. All conduit penetrations through interior walls and floors shall be sealed with fire retardant type conduit sealant.
- N. Conduit Identification: In each manhole, handhole, pull box, cabinet, motor control center or other equipment enclosure, identify each conduit using the conduit number shown on the Drawings by means of a stamped brass tag affixed with stainless steel wire; where affixing a tag is not feasible, identify conduits by stenciling. Stencil all exposed conduits for identification at least once in each room.
- O. Conduit Seals:
1. Moisture Seals: Provide in accordance with NEC paragraph 300-5(g).
 2. Gas Seals: Provide in accordance with NEC paragraph 501-5.
- P. Conduit in finished areas shall be installed concealed.

- Q. Conduit shall not be supported from T-bar ceiling suspension wires.
- R. Flexible metallic conduit shall have a maximum length of 6 feet. Flexible metallic conduit shall not be considered as a ground conductor. Flexible metallic conduit shall only be installed in exposed or accessible locations.
- S. Rigid PVC conduit shall be stored on a flat surface and shielded from the sun.
- T. ENMT shall not be installed in hazardous areas, in concrete, or direct earth buried.
- U. Paint all exposed conduits, boxes and fittings orange to match the standard color of electrical equipment at Waianae WWTP. Paint finishes shall include proper surface preparation, prime coat and a final finish coat, and shall conform to Section 09960.
- V. Existing conduit shall not be reused.

CONDUIT USE TABLE 1

Circuit Type	Inside Buildings							
	Exposed			Concealed				
Circuit Type	Standard	Corrosive	Hazardous	Above Suspended Ceilings	In Stud Walls	Embedded In Concrete	Slab On Grade	
Power and 120 Vac Control	GRS	PVC-coated GRS	GRS	GRS	GRS	PVC-40(*)	GRS	
Signal	GRS	GRS	GRS	GRS	GRS	PVC-40(*)	GRS	

CONDUIT USE TABLE 2

Circuit Type	Outside Buildings			Transition
	Exposed	Buried In Soil	Duct Bank Encased In Concrete	Within 5 Feet of Building
Power and 120 Vac Control	Type 316 Stainless Steel	PVC-40(*)	PVC-40(*)	Type 316 Stainless Steel
Signal	Type 316 Stainless Steel	PVC-40(*)	PVC-40(*)	Type 316 Stainless Steel

* Provide ground wire sized per NEC requirements for all circuits.

** PVC coated GRS in wet wells, etc., that are both hazardous and corrosive, otherwise, GRS.

Notes:

1. Generally, the Conduit Use Tables apply.
2. Signal circuits are those subject to RF interference or induced current. MSPs, TSPs, telephone cable, coaxial cable, and manufacturer's cables specially designed for low level signals are all presumed to be part of signal circuits.
3. Provide fiberglass conduit where indicated on the Drawings.

3.02 WIREWAY INSTALLATION

- A. Straight sections and fittings shall be solidly bolted together to be mechanically rigid and electrically continuous. Dead ends shall be closed. Unused conduit openings shall be plugged.
- B. Wireways shall be supported as required by NEC.
- C. Wireways and auxiliary gutters shall not contain wiring or control devices.

END OF SECTION

SECTION 16120

LOW VOLTAGE WIRE AND CABLE

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Provisions: Applicable provisions of Section 16010 become a part of this Section as if repeated herein.
- B. Related Work Described Elsewhere: Division 17.

1.02 REFERENCE STANDARDS

- A. ASTM International (ASTM):
 - 1. B3-74 Specification for Soft or Annealed Copper Wire
 - 2. B8-77 Specification for Concentric Lay Stranded Copper Conductors, Hard, Medium-Hard, or Soft
 - 3. B173-71 Specification for Rope Lay Stranded Copper Conductors Having Concentric Stranded Members
- B. Insulated Cable Engineers Association (ICEA):
 - 1. S-66-524 Cross-Linked Thermosetting Polyethylene Insulated Wire and Cable
- C. International Electrical Testing Association (NETA);
 - 1. ATS Acceptance Testing Specifications
- D. Underwriters Laboratories, Inc. (UL) Standards:
 - 1. 62 Flexible Cords and Fixture Wire
 - 2. 83 Thermoplastic-Insulated Wires and Cables
 - 3. 510 Insulating Tape
 - 4. 1063 Stranded Conductors for Machine Tool Wire

1.03 SUBMITTALS

- A. Submit material or equipment data in accordance with General Conditions Section 5 and the submittal requirements of Section 16010.

1.04 LOCATIONS

- A. Refer to Section 16010 for definitions of types of locations.

PART 2 - PRODUCTS

2.01 CONDUCTORS

- A. General: All conductors shall be copper. Wire or cable not specifically shown on the Drawings or specified, but required, shall be of the type and size required for the application and in conformance with the applicable code. All insulated conductors shall be identified with printing colored to contrast with the insulation color.

- B. Power and Control Conductors, 600 Volts and Below:
 - 1. Stranded copper wire shall be 600 volt Type THWN, Class B stranding, sizes #14 AWG and larger.
 - 2. Stranded copper wire shall be 600 volt Type XHHW or RHW, Class B stranding, Sizes #8 AWG and larger.
 - 3. Fixture wire shall be 600 volt, silicone rubber insulated, 200°C, UL Type SF-2, with stranded copper conductors.
 - 4. Cords shall be 600 volt, 2-conductor plus ground, Type SO, hard service, of adequate length and with grounding type plug attached, rated in amperes as shown on the Drawings.
 - 5. Cords shall be 600 volt, 2-conductor plus ground, Type SO, hard service, of adequate length and with grounding type plug attached, rated in amperes as shown on the Drawings.
 - 6. Control cable (CC) shall be 90°C, 600 volt, UL listed multiconductor tray cable, Type TC. Individual conductors shall be #14 AWG, unless otherwise noted. CC shall have 15 mils PVC insulation and 4 mils nylon over individual conductors; outer jacket shall be 45 mils thickness for up to 7 conductor cables and 60 mils for 9 through 19 conductor cables. Control cables shall be Dekoron Type IC99; Alpha Type TC; or approved substitute.
 - 7. VFD Cable: Provide multi-conductor shielded power cable from VFDs where identified on the Drawings. Conductor material shall be Class B stranded copper conforming to ASTM B-3 and B-8. Insulation shall be 90 degree C dry or wet, cross-linked polyethylene XLP in accordance with UL44. Individual conductors shall be cabled together with barrier tape, 100% shielding with foil tape and tinned copper braid (85% coverage) inside specially formulated PVC black jacket. Jacket to be PVC black jacket UL listed to -25 deg F, UL TC-ER listed. Minimum bend radius of 7.5x diameter. Flame resistance to be IEEE 383. Uses permitted include cable tray, conduit, exposed in normal or class 1, Div 2 per NEC 336, 392 and 501 environment. VFD cable shall be Southwire TC-VFD, OLFLEX VFD XL, or approved substitute.

2.02 SPLICES AND TERMINATIONS OF CONDUCTORS

- A. Splices:
 - 1. Wire and Cable Splicing Materials and Applications:
 - a. 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. They shall be UL listed and suitable for connecting two to four solid copper

- conductors of #14 or #12 AWG size or two or three #10 AWG solid copper conductors.
 - b. 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. They shall be UL listed.
 - c. Division 16 Equipment and Power Conductors: Bolted pressure connectors shall be suitable for the size and material of the conductors to be spliced. They shall be UL listed and of the split bolt or bolted split sleeve type in which the bolt or set screw does not bear directly on the conductor.
 - d. All Equipment: Epoxy splice kits shall include epoxy resin, hardener, and mold, and shall be suitable for use in wet locations and hazardous locations.
2. Terminal Cabinets: Provide terminal cabinets per Section 17510. Termination system shall include insulated, crimp-type connectors. Coordinate the lug and boards for correct fit. All terminations shall include marker sleeves.
 3. Splicing of cables and wires in the manholes and handholes shall be kept at a minimum.
- B. Terminations:
1. Low Voltage Terminations:
 - a. Crimp type terminals shall be UL listed, self-insulating sleeve type with nylon jacket, 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.
 - b. Terminal lugs shall be UL listed and of the split bolt or bolted split sleeve type in which the bolt or set screw does not bear directly on the conductor. Tongues shall have NEMA standard drilling.
 - c. Crimp with manufacturer recommended ratchet-type tool with calibrated dies. Hand crimping tools are not acceptable.
 - C. Tape used for splices and terminations shall be compatible with the insulation and jacket of the cable and shall be of plastic material. Tape shall conform with UL 510 and shall be Scotch 33 Plus.
 - D. Wire markers shall be heat shrink type: Raychem; T&B; or approved substitute. Wire numbers shall be permanently imprinted on the markers.

2.03 VFD WIRING

- A. Shielded power cables (TYPE VFD) shall be used for load-side wire between the VFDs located in MCCs and the motors.

PART 3 - EXECUTION

3.01 CONDUCTOR INSTALLATION

- A. Provide the following types and sizes of conductors for the uses indicated for 600 volts or less:
 1. Stranded Copper, Size #14 AWG and larger, individual conductors: As shown on the Drawings for the control of motors or other equipment. Size #14 shall not be used for power supplies to any equipment.
 2. Stranded Copper, Sizes #12 AWG and larger: As shown on the Drawings for motors and other power circuits.
 3. Fixture Wire: For connections to all fixtures in which the temperature may exceed the rating of branch circuit conductors.
- B. 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: Brown, orange and yellow.
 3. 120/240 Volt, 1 Phase: Red and black.
 4. Control Wiring: 120 VAC: Purple.
 5. Control Wiring: 24 VDC: Any color not used above.
- C. Color coding shall be in the conductor insulation for all conductors #10 AWG and smaller; for larger conductors, color shall be either in the insulation or in colored plastic tape applied at every location where the conductor is readily accessible (e.g., enclosures, pull boxes, and junction boxes).
- D. Exercise care in pulling wires and cables into conduit or wireways so as to avoid kinking, putting undue stress on the cables or otherwise abrading them. No grease will be permitted in pulling cables. Only soapstone, talc, or UL listed pulling compound will be permitted. The raceway construction shall be complete and protected from the weather before cable is pulled into it. Swab conduits before installing cables and exercise care in pulling, to avoid damage to conductors.
- E. Wrap all cables in manholes with fireproofing tape. Extend tape 1 inch into ducts.
- F. Cable bending radius shall be per applicable code. Install feeder cables in one continuous length unless splices are favorably reviewed.
- G. Provide an equipment grounding conductor, whether or not it is shown on the Drawings, in any flexible conduit or any raceway in which all or any portion of a run consists of non-metallic duct or conduit. For flexible conduit, an external bonding jumper is an acceptable alternative.

- H. In panels, bundle incoming wire and cables, No. 6 AWG and smaller, lace at intervals not greater than 6 inches, neatly spread into trees and connect to their respective terminals. Allow sufficient slack in cables for alterations in terminal connections. Perform lacing with plastic cable ties or linen lacing twine. Where plastic panel wiring duct is provided for cable runs, lacing is not necessary when the cable is properly installed in the duct.
 - I. For cables crossing hinges, utilize extra flexible stranded wire, make up into groups not exceeding 12, and arrange so that they will be protected from chafing and excess flexing when the hinged member is moved.

3.02 CONDUCTOR SPLICES AND TERMINATIONS

- A. Splices: Install all conductors without splices unless necessary for installation, as determined by the Officer-in-Charge. Splices, when permitted, and terminations shall be in accordance with the splice or termination kit manufacturer's instructions. Splice or terminate wire and cable as follows:
 - 1. Watertight Splices: Splices in concrete pull boxes, for any type of cable or wire, shall be watertight. Make splices in low voltage cables using epoxy resin splicing kits rated for application up to 600 volts.
- B. Terminations:
 - 1. Terminate stranded #14 wire using crimp type terminals where not terminated in a box lug type terminal. Terminals must be coordinated with type of terminal board where provided.

3.03 CONDUCTOR IDENTIFICATION

- A. Except for interior lighting and receptacle circuits, identify each wire or cable at each termination and in each pull box, 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 or as favorably reviewed by the Officer-in-Charge.
- B. Conductor numbering shall be coordinated with the Interconnection Diagrams specified in Section 17010.
- C. 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.
- D. Wire markers at wire ends shall be shrinkable sleeve type. Wire numbers shall be permanently imprinted on the markers. Wire markers shall be Brady Permasleeve; Brady Bradysleeve; or approved substitute.

- E. Wire markers installed in each pull box, junction box, and handhole shall be Brady or approved substitute.

3.04 FIELD TESTS

- A. Insulation Resistance Tests: For all circuits 150 volts to ground or more and for all motor circuits over 1/2 horsepower, test cables per NETA Paragraph 8.3.1. The insulation resistance shall be 20 megohms or more. Submit results for review. See also Section 16010.
- B. Phase Rotation: The phase rotation of all circuits shall be clockwise in sequence. The Contractor shall verify that each three-phase service, feeder and branch circuits meet this requirement. A record shall be kept at each circuit tested and, on completion, given to the Officer-in-Charge for review.

END OF SECTION

SECTION 16124

SIGNAL CABLE

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Provisions: Applicable provisions of Section 16010 become a part of this Section as if repeated herein.
- B. Related Work Described Elsewhere:
 - 1. Section 17010: Instrumentation and Controls, General Requirements

1.02 REFERENCE STANDARDS

- A. ASTM International (ASTM):
 - 1. B8 Concentric Lay Stranded Copper Conductors, Hard, Medium-Hard, or Soft, Specification for
- B. Institute of Electrical and Electronic Engineers (IEEE):
 - 1. 383 Shielded Instrumentation Cable, Specifications for
- C. Underwriters Laboratories, Inc. (UL):
 - 1. 13 Power Limited Circuit Cable Class 2, Specifications for (Bulletin)
 - 2. 83 Thermoplastic Insulated Wires and Cables

1.03 SUBMITTALS

- A. Submit material or equipment data in accordance with General Conditions Section 5 and the submittal requirements of Section 16010.

PART 2 - PRODUCTS

2.01 TWISTED SHIELDED PAIRS (TSP)

- A. 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. Conductors shall be twisted with 2-inch or shorter lay, with 100% foil shielding and tinned copper drain wires. Each pair shall have a 35-mil-thick outer jacket. Cable shall be rated at 90°C and for operation of 600 volts, as noted on the Drawings. Provide Alpha 5616B1601; Dekoron 1852-6860R; or approved substitute.

2.02 MULTIPLE (TWISTED) SHIELDED PAIR (MSP) CABLES

- A. Each MSP cable shall conform to IEEE 383, UL 13, and UL 83 and shall consist of the number of pairs shown on the Drawings, of #20 AWG, 7-strand

copper conductors per ASTM B8. Conductors shall have 15 mil PVC insulation and shall be twisted in 2-inch or shorter lay. Each pair shall have a 100% foil shield and a tinned copper drain wire. The MSP cable itself shall have, in addition, an overall foil shield, tinned copper drain wire, and an outer PVC jacket. Thickness of the jacket shall be 50 mils for 8 or fewer pairs, 60 mils for 10 to 16 pairs, and 70 mils for 18 or more pairs. Provide Alpha 5620B20XX; Dekoron 1874-XXX80; or approved substitute.

2.03 SPECIAL CABLES

- A. Use only coaxial cable recommended for specific applications such as radio antenna systems and computer networks as required by the manufacturer or system supplier. Due to wide differences in electrical ratings and physical characteristics between cable types, any deviations from manufacturers recommended types, cable is not acceptable.

PART 3 - EXECUTION

3.01 CABLE INSTALLATION

- A. Signal cable shall be installed by personnel who are experienced in terminating and splicing twisted shielded conductors and co-axial cables. Include on experience spreadsheet.
- B. Adequate care shall be exercised by the installers to prevent cable damage or sheath distortion. Bending radius shall not be less than 10 times the cable O.D.
- C. Cables shall be continuous from initiation to termination without splices except where specifically indicated.
- D. Cable shielding shall be grounded at one end only of the cable. Bonding shall be to a single ground point only. Bonding from cable to cable in multiple run installations shall not be permitted.
- E. Heat shrinkable sleeving shall be installed on all cables to insulate shielding at the ungrounded cable terminations.
- F. Where installed in control consoles containing power circuits, cables shall be routed a minimum of 2 inches distant. Color coding shall be strictly observed throughout the installation.
- G. Manufacturer's cable pulling tension shall not be exceeded.

3.02 CONDUCTOR SPLICES AND TERMINATIONS

- A. Splices: Install all conductors without splices unless necessary for installation, as determined by the Officer-in-Charge. Splices, when permitted,

and terminations shall be in accordance with the splice or termination kit manufacturer's instructions. Splice cables as follows:

1. Watertight Splices: Splices in concrete pull boxes, for any type of cable or wire, shall be watertight. Make splices in low voltage cables using epoxy resin splicing kits rated for application up to 600 volts.
2. Terminal Cabinets:
 - a. When splices are permitted by the Officer-in-Charge, install terminal cabinet per Section 17510. Terminal system shall include insulated, crimp-type connectors and barrier-type terminal boards. Coordinate the lug and boards for correct fit. All terminations shall include marker sleeves.
 - b. Shields shall be handled as a separate conductor. Use manufacturer's compression sleeve and insulated pigtail. Keep pigtail as short as possible. Terminate pigtail with marker sleeve and tug.
3. No splicing is acceptable for coaxial cables.

B. Terminations:

1. Crimp-type terminals shall be UL listed, self-insulating, sleeve type with ring or rectangular tongue, suitable for size and material of the wire to be terminated and for use with either stranded or solid wire. Spade type lugs are acceptable with telephone (TC) cable systems only.
2. Crimp with manufacturer's recommended ratchet-type tool with calibrated dies. Hand crimping tools are not acceptable.
3. Coaxial cable and connectors shall be terminated in accordance with the manufacturer's instructions. Use manufacturer's recommended solder. The Contractor shall prevent misapplication of solder and termination.
4. Splicing of TSP is unacceptable unless written exception from Officer-in-Charge.

3.03 CONDUCTOR IDENTIFICATION

- A. Identify each wire or cable at each termination, in each pull box, and in each handhole 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 or as favorably reviewed by the Officer-in-Charge. Conductor numbering shall be coordinated with the Interconnection Diagrams specified in Section 17010.
- B. 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.

3.04 FIELD TESTS

- A. Insulation Resistance Tests: Perform insulation resistance tests on all circuits. Make these tests before any equipment has been connected. Test the insulation with a 250 VDC insulation resistance tester with a scale reading 100 megohms. The insulation resistance shall be 20 megohms or more. Submit results for review.

END OF SECTION

SECTION 16130

BOXES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Provisions: Applicable provisions of Section 16010 become part of this Section as if repeated herein.
- B. Work Included:
 - 1. Installation of all necessary outlet boxes for wiring devices, lighting fixtures, and signal equipment as noted on the Drawings.
 - 2. Installation of junction boxes as required for the consolidation of conduit runs.
 - 3. Installation of pull boxes as necessary to aid in pulling in conductor.

1.02 REFERENCE STANDARDS

- A. ASTM International (ASTM):
 - 1. A123 Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products
- B. Federal Specifications (FS):
 - 1. W-C-586 Conduit Outlet Boxes, Bodies, and Entrance Caps, Electrical, Cast Metal
 - 2. W-J-800 Juncti
on Box, Extension, Junction Box Cover, Junction Box
(Steel, Cadmium or Zinc Coated)
- C. Underwriters Laboratories, Inc. (UL) Publications:
 - 1. 50 Electrical Cabinets and Boxes
 - 2. 514 Outlet Boxes and Fittings

1.03 SUBMITTALS

- A. Submit material or equipment data in accordance with General Conditions Section 5 and the submittal requirements of Section 16010.

PART 2 - PRODUCTS

2.01 OUTLET, JUNCTION, AND PULL BOXES

- A. Metal Boxes: Boxes shall be Type 316 stainless steel. 14 gauge minimum.

- B. Outlet boxes and switch boxes shall be designed for mounting flush wiring devices. Boxes and box extension rings shall be provided with knockouts. Boxes shall be formed in one piece from carbon-steel sheets. Outlet boxes shall not be less than 4 inches square and 1-7/8 inches deep. Ceiling boxes shall withstand a vertical force of 200 pounds for 5 minutes. Wall boxes shall withstand a vertical downward force of 50 pounds for 5 minutes. Gangable and through-wall types are not acceptable. Boxes shall conform to FS W-J-800D and UL 514.
- C. Cast Metal Boxes: Box bodies and cover shall be cast or malleable iron with a minimum wall thickness of 1/8 inch at every point, and not less than 1/4 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.
- D. Non-metallic Boxes: Non-metallic boxes shall be hot-compressed fiberglass, one-piece, molded with reinforcing of polyester material, with minimum wall thickness of 1/8 inch.
- E. Pull Boxes and Junction Boxes: Except where NEMA 4X fiberglass boxes are called for, all boxes shall be fabricated from Type 316 stainless steel. Boxes shall be welded construction with all seams or joints closed and reinforced. Boxes intended for outdoor use shall be cast metal with threaded hubs and neoprene gasketed covers, or shall be of the fiberglass reinforced polyester type of 1/8 inch minimum thickness. Cover retention shall be by corrosion resistant stainless steel screws.
 - 1. All boxes for wiring operating at 601 volts or higher shall be constructed without hinges and shall be padlockable.
 - 2. All boxes and cabinets shall be securely fastened to building structural members so as to prevent movement in any direction. Boxes shall not be supported by lighting fixtures, suspended ceiling support wires or freely hanging rods.
 - a. Covers of boxes and cabinets mounted in horizontal plane (top or bottom) shall either weigh not more than 40 pounds or shall require not more than 40 pounds of force to open or close.
 - b. Covers of boxes and cabinets mounted in vertical plane (front, back, sides) shall either weigh not more than 60 pounds or shall require not more than 60 pounds of force to open or close. All covers over 30 pounds shall be furnished with angle support at bottom to carry weight of cover for assembly.
 - c. Covers of boxes and cabinets weighing more than 30 pounds shall be provided with lifting handles or some means of grasping other than edges.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Outlet Boxes:
 - 1. Provide fixture outlets with proper fixture connectors.
 - 2. Box mounting height shall be dictated by the wiring device enclosed.
 - 3. Blanking covers shall be installed on all unused openings.
 - 4. Cast metal or molded non-metallic surface mounted boxes shall be used in exterior and/or in all wet locations.
 - 5. Bonding jumpers shall be used around all concentric or eccentric knockouts.
 - 6. Boxes shall be securely mounted to the building structure independent of conduits entering or exiting the boxes.

- B. Junction Boxes and Pull Boxes:
 - 1. Boxes shall be installed where required and where indicated on the Drawings.
 - 2. Boxes shall be readily accessible.
 - 3. Boxes shall not be installed in finished areas.
 - 4. Pull boxes shall be provided at least every 150 feet on long straight conduit runs. Spacing shall be reduced by 50 feet for each 90 degree bend. See Section 16110 for maximum bends in conduit systems.
 - 5. Box dimensions shall be in accordance with size and quantity of conductors and conduits entering and leaving box per NEC Article 314 requirements.
 - 6. All boxes, both new and existing, for medium voltage systems shall be permanently marked "High Voltage" on all surfaces with red letters which are at least 4 inches high.

END OF SECTION

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SECTION 16140

WIRING DEVICES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Provisions: Applicable provisions of Section 16010 become a part of this Section as if repeated herein.
- B. Work Included:
 - 1. Installation, connection and furnishing all single, duplex, GFI and special purpose receptacles complete with wall plates and/or covers as shown on the Drawings.
 - 2. Installation, connection and furnishing of all single pole, three-way, pilot light and momentary position toggle switches complete with wall plates and or handle operators as shown on the Drawings.

1.02 REFERENCE STANDARDS

- A. American National Standards Institute (ANSI) Publication:
 - 1. C73 Plugs and Receptacles
 - 2. C73a Plugs and Receptacles
- B. Federal Specifications (FS):
 - 1. W-C-596 D & E General Specifications for Cable Outlet Electrical Connector
 - 2. W-S-896 D & E General Specifications for Flush Mounted Toggle and Lock Switches
- C. National Electrical Manufacturers Association (NEMA) Publications:
 - 1. WD 1 General Requirements for Wiring Devices
 - 2. WD 6 Wiring Devices - Dimensional Requirements
- D. Underwriters Laboratories, Inc. (UL) Standards:
 - 1. 20 General-Use Snap Switches
 - 2. 498 Electrical Attachment Plugs and Receptacles
 - 3. 514 Electrical Outlet Boxes
 - 4. 943 Class A Ground Fault Receptacle Interrupting Requirements

1.03 SUBMITTALS

- A. Submit material or equipment data in accordance with General Conditions Section 5 and the submittal requirements of Section 16010.

1.04 LOCATIONS

- A. Refer to Section 16010 for definitions of types of locations.

PART 2 - PRODUCTS

2.01 RECEPTACLES

- A. General: Receptacles shall be heavy duty, high abuse, grounding type conforming to NEMA configurations, NEMA WD1 and UL 514 Standards.
- B. Single and Duplex Receptacles:
 1. Receptacles shall be of back and side wire design utilizing screw type terminals. Receptacles shall be rated 20 ampere, two-pole, 3-wire, 120-volt, NEMA 5-20 configuration, self-grounding. Color shall be brown in industrial areas and ivory or white in office and laboratory areas. Power contacts shall be a T-type design and shall be brass. Ground contacts shall be brass.
 2. Devices shall have a nylon composition face with a nylon or melamine body. Units shall comply with Federal Specification W-C-596E and meet UL 498 test requirements. Receptacles shall be Hubbell 5362; or approved substitute.
- C. Special Purpose Receptacles: Receptacles shall be of the amperage, voltage and NEMA configuration indicated on the Drawings. Compliance to standards and tests shall be as listed in Item B above.
- D. GFI Receptacles:
 1. Device shall be rated 20 ampere, 2-pole, 3-wire, 120 volt, conforming to NEMA WD1.10 configuration. Face shall be nylon composition meeting UL 498 test standards. Unit shall have test and reset push buttons. Reset push button shall have a visible indicator band to indicate tripped condition.
 2. GFCI component shall meet UL 498 Class A standards with a tripping time of 1/40 second at 5 milliamperes current unbalance. Operating range shall extend from 31°F to 158°F. Unit shall have transient voltage protection and shall be ceramic encapsulated for protection against moisture.
 3. Provide Hubbell 5362; or approved substitute.
- E. Isolated Ground Receptacles: Units shall comply with standards listed in Item B above, but shall have the ground contacts well isolated from the body mounting strap and shall be connected only to the separate grounding screw. Face color shall be orange to identify this feature. Provide Hubbell Catalog No. IG5262, IG5362; or approved substitute.

- F. Corrosion Resistant Receptacles: Units shall comply with standards listed in Item B above, but shall also have tin-nickel plated brass connecting equipment and stainless steel hardware. Receptacle face color shall be yellow to identify the device as having these special qualities. Provide Hubbell Catalog No. 52CM62 and 53CM62; or approved substitute.
- G. Load Break Power Receptacles: Special purpose receptacles shall be of the amperage and voltage rating, number of poles, and pin configuration indicated on the Drawings. Units shall be supplied with matching plugs and shall be capable of interrupting, without any device damage, the full amperage rating.
- H. Surface Multiple Outlet Assemblies: Units shall have outlets on center-to-center spacing as indicated on the Drawings. Assembly shall conform to Article 353 of the NEC and receptacles shall conform to the standards listed in Item A above.
- I. Explosion Proof Receptacles: Devices shall be UL listed for use in Class 1, Division 1 or Division 2, or for Class 2, Division 1 areas as indicated on the Drawings. Units shall be factory sealed types where available and shall contain disconnecting mechanisms which must function prior to plug withdrawal or after insertion.
 - 1. All 20 amp, 120 and 240 volt, 2 pole, 3 wire receptacles shall be NEMA 5-20R and NEMA 6-20R. Receptacles shall be UL classified as interchangeable with male plugs of other manufacturers. Provide Killark Receptacle No. UCR520231, 20 amp, 125 volt feed through 3/4-inch hub; Killark Receptacle No. UCR520232, 20 amp, 250 volt feed through 3/4-inch hub; Crouse-Hinds; or approved substitute.
 - 2. For 30 amp and above devices shall be Killark copper-free aluminum KR Series for Class 1, Division I and Division II C and D; Crouse-Hinds; or approved substitute.
 - 3. For corrosive areas devices shall be Killark CES Series 8575, 8578, and 8579 non-metallic plugs and switched receptacles suitable for Class 1, Division II Groups A, B, C, D; Class 2, Division I and II E, F, G; and Class 3, NEMA 3, 3R, 3S, 7, Division II and NEMA 9; Crouse-Hinds; or approved substitute.

2.02 SWITCHES

- A. Line Voltage Types: Switches shall be rated 20 amperes 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 and laboratory areas. Units shall conform to Federal Specifications W-S-896 D and E, UL 20, and NEMA WD1 standards. Daniel Woodhead 1900 Series; or approved substitute.

- B. Low Voltage Types: Switches shall meet all of the requirements listed in Item A above except to be rated at 15 amperes for switching 24 Volts dc. Devices shall be three-position, momentary contact, spring return, center "off" configuration.
- C. Explosion Proof Types: Units shall conform to the standards listed in Item A above, but in addition shall have UL listings for use in hazardous areas classified as Class 1, Division I or II, and Class 2, Division I. Units shall be factory sealed devices. Material shall be copper-free aluminum for metallic types. Provide Killark FSK, Seal X Series; Crouse-Hinds; or approved substitute. Provide fiberglass or polyamide for non-metallic types.

2.03 PLATES

- A. General: Plates shall be of the style and color to match the wiring devices, and of the required number of gangs. Plates shall conform with NEMA WD1, UL 514, and ANSI C73. Plates on finished walls shall be non-metallic or stainless steel. Plates on unfinished walls and on fittings shall be of zinc plated steel or cast metal having rounded corners and beveled edges.
- B. Non-Metallic: Plates shall be smooth finish with contoured edges and shall be nylon or fiberglass.
- C. Stainless Steel: Plates shall be 0.035 inches thick with beveled edges and shall be manufactured from No. 302 alloy having a brushed or satin finish.
- D. Cast Metal: Plates shall be cast or malleable iron covers with gaskets so as to be moisture resistant or weatherproof.
- E. Blank Plates: Cover plates shall be stainless steel.
- F. Damp or Wet and Corrosive Locations: Plates shall have weather protective double doors. Material of manufacture shall be Type 316 stainless steel or nylon for non-metallic plates.

PART 3 - EXECUTION

3.01 INSTALLATION OF WIRING DEVICES

- A. Dry Locations: The device shall be installed in surface mounted boxes.
- B. Damp or Wet Exterior Locations: Install only wiring devices approved for outdoor service in these locations.

C. Mounting Heights: Locations of wall outlets shall be measured from the finished floor to the center of the outlet box. Height above finished floor shall be as follows:

	<u>Inches from Floor</u>
Receptacles - Industrial Areas	46
Toggle Switches	46

D. Damp or Wet Interior Locations: Install only wiring devices approved for outdoor service.

E. Receptacles:

1. Receptacles shall be grounded by a grounding conductor, not by a yoke or screw contact.
2. Receptacles shall be oriented so that the grounding slot is located at the top of the outlet.
3. Receptacles shall be installed with connections pigtailed (spliced) to the branch circuit wiring so that removal of the receptacle will not lose neutral continuity and branch circuit power will not be lost to other receptacles on the same circuit.

3.02 INSTALLATION OF WALL PLATES

- A. General: Plates shall match the style of the device and shall be plumb within 1/16 inch of the vertical or horizontal.
- B. Interior Dry Locations: Do not use oversize plates or sectional plates.
- C. Exterior and/or Wet Locations: Install plates with gaskets on wiring devices in such a manner as to provide a raintight weatherproof installation. Cover type shall match box type.
- D. Future Locations: Install blanking cover plates on all unused outlets.

3.03 TESTS

A. Receptacles:

1. Receptacles shall be tested for blade and ground plug tension prior to installation. Do not install any receptacle having less than 16 ounce individual blade retention.
2. After installation of receptacles, circuits shall be energized and each receptacle tested for proper ground continuity, reversed polarity, and/or open neutral condition.
3. 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.

END OF SECTION

SECTION 16160

PANELBOARDS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Provisions: Applicable provisions of Section 16010 become a part of this Section as if repeated herein.

1.02 REFERENCE STANDARDS

- A. American National Standards Institute (ANSI) Publication:
 - 1. Z55.1 Gray Finishes for Industrial Apparatus and Equipment
- B. National Electrical Manufacturers Association (NEMA) Publications:
 - 1. PB 1 Panelboards
 - 2. 250 Enclosures for Electrical Equipment (1,000 Volt Maximum)
- C. Federal Specifications (FS):
 - 1. W-P-115 Panel, Power Distribution
 - 2. W-C-375 Circuit Breakers, Molded Case, Branch Circuit and Series Service, Series Trip
- D. Underwriters Laboratories, Inc. (UL) Standards:
 - 1. 50 Electrical Cabinets and Boxes
 - 2. 869 Electrical Service Equipment
 - 3. 869A Reference Standard for Device Equipment

1.03 SUBMITTALS

- A. Submit material or equipment data in accordance with General Conditions Section 5 and the submittal requirements of Section 16010.
- B. Shop Drawings: For each panelboard, submit manufacturer's name and data as required:
 - 1. Panelboard type.
 - 2. Main bus and terminal connection sizes.
 - 3. Location of line connections.
 - 4. Cabinet dimensions.
 - 5. Gutter space.
 - 6. Gauge of boxes and fronts.
 - 7. Finish data.
 - 8. Voltage rating.
 - 9. Breaker types, trip ratings, and interrupting ratings.

1.04 LOCATIONS

- A. Refer to Section 16010 for definitions of types of locations.

PART 2 - PRODUCTS

2.01 PANELBOARDS

- A. General: All panelboards shall be the automatic circuit breaker type. The number and arrangement of circuits, trip ratings, spares and blank spaces for future circuit breakers shall be as shown on the Drawings. All circuit breakers shall be quick-make, quick-break, thermal magnetic, bolt-on type, and 1, 2 or 3 pole as shown, each with a single operating handle.
 1. Each panelboard shall have a field-mounted identifying plastic nameplate giving the panel identification as shown on the Drawings. In addition, each panelboard shall have a manufacturer's nameplate showing the voltage, bus rating, phase, frequency, and number of wires.
 2. For panelboards used in dry locations, finish of doors and trim shall be ANSI 61 or 49, in accordance with ANSI Z55.1. Boxes of all such panelboards shall be galvanized, field finished to match the fronts.
 3. Where specified, panelboards shall have NEMA 3R/12 and/or NEMA 4X enclosures.
 4. Panelboards and enclosures shall conform to NEMA PB1 and 250, UL 50 and requirements of all relevant codes. Panelboards used as service equipment shall conform to UL 869.
- B. Distribution Panelboards: Distribution panelboards shall be rated 480Y/277 volts, 4-wire, with bus ratings as shown on the Drawings. They shall meet the requirements of Federal Specification W-P-115 for Type I, Class 1 panelboards with circuit breakers meeting Federal Specification W-C-375 for Class 2d and 3a circuit breakers. Distribution panelboards shall be large enough for double branch mounting of branch circuit breakers up to 600 amp and shall be surface mounted. Circuit breakers shall have minimum interrupting ratings of 14,000 RMS symmetrical amperes at 480 volts.
 1. Each branch circuit shall be identified by an engraved plastic nameplate as shown on the Drawings.
 2. Distribution panelboards shall be Square D I-Line with Type FA or larger breakers; Eaton Pow-R-Line C Type FDB or larger breakers; or approved substitute.
- C. Lighting Panelboards:
 1. General: Lighting panelboards shall be rated as shown on the Drawings. Panelboards shall meet the requirements of Federal Specification W-P-115 for Type I, Class 1 panelboards with circuit breakers.

2. Lighting panelboards shall have front doors with key latch, common keying and a typed directory card and holder. Panelboard circuits shall be arranged with odd numbers on the left and even numbers on the right.
3. Circuit Breakers: Circuit breakers shall be the molded case type with ratings as shown on the Drawings. Circuit breakers shall have interrupting ratings of 10,000 RMS symmetrical amperes at 120/240 VAC.
4. Manufacturer: Panelboards shall be Cutler Hammer Pow-R-Line C; Square D NQOD; or approved substitute.

2.02 SELF-CONTAINED POWER CENTERS

- A. General: Self-contained power centers shall consist of a combination dry type transformer with primary breaker, a secondary breaker, and a lighting panelboard. Breakers shall be plug-on type. Transformer shall have 115°C rise insulation. The complete unit shall be UL labeled for Service Entrance Equipment and be suitable for outdoor use.
- B. Provide Square D Mini Power-Zone, Cutler Hammer Mini-Power Centers, or approved substitute.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Panelboards shall be installed as indicated on the Drawings and in accordance with the manufacturer's instructions. Provide a panelboard directory indicating up-to-date circuits during construction. Directory shall be typed and shall indicate panelboard power source. No handwritten directory is acceptable.
- B. Each panel shall have a neatly typewritten directory with the name and the room or the equipment served by each circuit breaker which shall correspond with the final circuit arrangement. Spaces in directories for spare circuit breakers shall be neatly marked "Spare" in pencil. The directory shall also indicate the panel designation, voltage, and phase at the top. Each directory shall be mounted in metallic index cardholder behind a clear plastic window.

3.02 MOUNTING HEIGHTS

- A. Lighting and distribution panelboards shall be mounted with the top of the box 6-feet-6-inches above the floor. Panelboards shall be plumb within 1/8 inch. The highest breaker operating handle shall not be higher than 72 inches above the floor.

3.03 FIELD TESTS

- A. Insulation Resistance Tests: Perform insulation resistance tests on circuits to be energized with a line-to-neutral voltage of 120 volts or more. Make these tests after all equipment has been connected, except that equipment, which may be damaged by the test voltage, shall not be connected. Test the insulation with a 500 Vdc insulation resistance tester with a scale reading 100 megohms. The insulation resistance shall be 20 megohms or more. Submit results for review.
- B. Grounding: Panelboard grounding shall conform to Section 16450.
- C. Continuity: Panelboard circuits shall be tested for continuity prior to energizing. Continuity tests shall be conducted using a dc device with a tone indicator.

END OF SECTION

SECTION 16180

PROTECTIVE DEVICES AND SWITCHES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Provisions: Applicable provisions of Section 16010 become a part of this Section as if repeated herein.
- B. Work Included: Provide all necessary labor, tools and material to install circuit protective devices as shown on the Drawings and as described in these Specifications.

1.02 REFERENCE STANDARDS

- A. American National Standards Institute (ANSI) Publication:
 - 1. Z55.1 Gray Finishes for Industrial Apparatus and Equipment
- B. National Electrical Manufacturers Association (NEMA) Publications:
 - 1. ICS 3 Industrial Systems
 - 2. ICS 6 Enclosures for Industrial Controls and Systems
 - 3. 250 Type 1 Enclosures for Electrical Equipment (1,000 Volts Maximum)
- C. Federal Specifications (FS):
 - 1. W-C-375 Circuit Breakers, Molded Case, Branch Circuit and Series Service, Series Trip
 - 2. W-F-1726 Class H Cartridge Fuses
- D. Underwriters Laboratories, Inc. (UL) Standards:
 - 1. 50 Electrical Cabinets and Boxes
 - 2. 198C Fuses, High-Interrupting-Capacity-Current Limiting Types
 - 3. 489 Molded Case Circuit Breakers and Enclosures
 - 4. 698 Industrial Control Equipment for Use in Hazardous (Classified) Locations
 - 5. 894 Switches for Use in Hazardous (Classified) Locations
- E. National Fire Protection Association (NFPA) Publication:
 - 1. 70 National Electric Code

1.03 SUBMITTALS

- A. Submit material or equipment data in accordance with the General Conditions Section 5 and the submittal requirements of Section 16010.

1.04 LOCATIONS

- A. Refer to Section 16010 for definitions of types of locations.

PART 2 - PRODUCTS

2.01 FUSIBLE SWITCHES

- A. Fusible switches shall be heavy duty safety switches with the voltage ratings, current ratings, and number of poles as indicated by the Drawings. The switches shall be horsepower rated. Auxiliary contacts shall be provided as indicated on the Drawings. Stationary contacts shall be equipped with arc chutes. Fuse clips shall accept only Class J current limiting cartridge fuses. Where indicated on the Drawings, units shall have service entrance labels and shall be equipped with an insulated neutral lug. Switches shall be Square D, Type HD; Eaton Type H600; or approved substitute.
- B. Enclosures shall be as follows:
 1. NEMA 4X Type 316 stainless steel.
- C. Nameplates: Provide an engraved plastic nameplate for each disconnect switch identifying the equipment it protects.
- D. Fuses:
 1. General: Provide one complete set of fuses of each ampere rating shown on the Drawings plus one spare set for each size shown.
 2. Fuse Type: Units shall be Class J current limiting, 700 volt, in the ampere ratings shown. Plug fuses are unacceptable. Barrels shall be non-hygroscopic with brass knurled ferrules.
 3. Fuses shall conform to FS W-F-1726 and UL 198B, and shall carry labels showing UL class, interrupting rating, time delay characteristics, and voltage rating.

2.02 ENCLOSED CIRCUIT BREAKERS

- A. Units shall be thermal-magnetic molded case circuit breakers in surface mounted non-ventilated enclosures conforming to the appropriate articles of NEMA 250, as follows:
 1. NEMA 4X Type 316 stainless steel.
 2. Explosive Locations: NEMA Type 7.
- B. Each unit shall have an external operating handle with a cover interlocking mechanism which will prevent opening of the enclosure when the operating handle is in the "ON" position. The handle shall be capable of being padlocked in either the "ON" or the "OFF" position. A breaker "tripped" position shall be clearly indicated between the "ON" and the "OFF" position.

- C. Where indicated on the Drawings, enclosed breakers used as service entrance equipment shall be so labeled for such service and shall contain an insulated neutral lug. The complete unit shall conform to UL 489.
- D. The circuit breakers shall be of the voltage, number of poles, frame size and ampere rating shown on the Drawings. Units shall be manually operated, trip-free, thermal-magnetic, molded case, front mounted circuit breakers.
 - 1. Frame sizes larger than 100 amperes shall have adjustable instantaneous magnetic elements. Minimum interrupting rating shall not be less than 10,000 amps asymmetrical and the breaker shall conform to FS W-C-375. Multiple breakers shall have a common trip single operating handle with three positions of indication. Circuit breaker shall be calibrated at 40°C (104°F).
 - 2. Each breaker shall be completely enclosed in a molded case with the calibrated sensing element factory sealed to prevent tampering.

2.03 DISCONNECT SWITCHES

- A. Disconnect switches shall be heavy duty safety switches with the voltage ratings, current ratings, and number of poles as indicated by the Drawings. The switches shall be 600 volt type and horsepower rated. Auxiliary contacts shall be provided as indicated on the Drawings. Switches shall be Cutler Hammer DH Series; Siemens HNF Series; or approved substitute.
- B. Enclosures shall be as follows:
 - 1. NEMA 4X Type 316 stainless steel.
 - 2. Explosive Locations: NEMA Type 7.
- C. Nameplates: Provide an engraved plastic nameplate for each disconnect switch identifying the motorized equipment it controls.

2.04 CONTROL STATIONS

- A. Control station shall be of Type 316 stainless steel for use with control devices. Unit shall include a lockout on "STOP" button, neoprene covers for front operated pushbuttons, and a lockout on selector switch covers (locks two- or three-position handle in any position). Receptacle housing shall be copper-free aluminum. Insulation shall be dialyl phthalate (DAP) and contacts shall be brass. Rocker handles, push buttons and guards shall be Type 6/6 nylon. Shaft and shaft bushings shall be stainless steel. Control stations shall be Crouse-Hinds, Series DSD; or approved substitute.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install units plumb within 1/8 inch of vertical, and in accordance with manufacturer's instructions. Make sure that fuse ratings are as shown on the Drawings, and that breaker trip settings are per the Officer-in-Charge's instructions.

3.02 MOUNTING HEIGHTS

- A. Fusible switches and enclosed circuit breakers shall be centered 5'-0" above the floor.

3.03 FIELD TESTS

- A. Insulation Resistance Tests: Perform insulation resistance tests on circuits to be energized with a line-to-neutral voltage of 120 volts or more. Make these tests after all equipment has been connected, except that equipment which may be damaged by the test voltage shall not be connected. Test the insulation with a 500 Vdc insulation resistance tester with a scale reading 100 megohms. The insulation resistance shall be 20 megohms or more. Submit results for review.
- B. Continuity Tests: Perform circuit continuity tests from a low powered dc test source to operate an audible tone device. Tests shall be made prior to energizing the protected circuit.
- C. Operating Tests: Demonstrate that the protected circuit can be manually controlled by the installed equipment.

END OF SECTION

SECTION 16235
ENGINE GENERATORS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes packaged engine-generator sets suitable for use in mission critical applications with the features as specified and indicated. Engine generators will be used as the Standby power source for the system, but shall be capable of providing reliable power with no run-time limitations while the primary source of power is unavailable.

1.03 DEFINITIONS

- A. Emergency Standby Power (ESP): Per ISO 8528: The maximum power available during a variable electrical power sequence, under the stated operating conditions, for which a generating set is capable of delivering in the event of a utility power outage or under test conditions for up to 200 hours of operation per year with the maintenance intervals and procedures being carried out as prescribed by the manufacturers. The permissible average power output (P_{pp}) over 24 hours of operation shall not exceed 70 percent of the ESP unless otherwise agreed by the RIC engine manufacturer.
- B. Prime Power (PRP): Per ISO 8528: The maximum power which a generating set is capable of delivering continuously whilst supplying a variable electrical load when operated for an unlimited number of hours per year under the agreed operating conditions with the maintenance intervals and procedures being carried out as a prescribed by the manufacturer. The permissible average power output (P_{pp}) over 24 hours of operation shall not exceed 70 percent of the PRP unless otherwise agreed by the RIC engine manufacturer.
- C. Limited Time running Power (LTP): Per ISO 8528: The maximum power available, under the agreed operating conditions, for which the generating set is capable of delivering for up to 500 hours of operation per year with the maintenance intervals and procedures being carried out as prescribed by the manufacturers.
- D. Continuous Operating Power (COP): Per ISO 8528: The maximum power which a generating set is capable of delivering continuously whilst

supplying a constant electrical load when operated for an unlimited number of hours per year under the agreed operating conditions with the maintenance intervals and procedures being carried out as a prescribed by the manufacturer.

- E. Data Center Continuous (DCC): The maximum power which a generating set is capable of delivering continuously whilst supplying a variable or constant electrical load when operated for an unlimited number of hours in a data center application under the agreed operating conditions with the maintenance intervals and procedures being carried out as a prescribed by the manufacturer. The permissible average power output (P_{pp}) over 24 hours of operation shall not exceed 100 percent of the DCC rating.
- F. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:
 1. Thermal damage curve for generator.
 2. Time-current characteristic curves for generator protective device.
 3. Sound test data, based on a free field requirement.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, and location and size of each field connection.
 1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
 2. Wiring Diagrams: Control interconnection, Customer connections.
- C. Certifications:
 1. Submit statement of compliance which states the proposed product(s) is certified to the emissions standards required by the location for EPA, stationary emergency application.
 2. Product(s) shall be preapproved for California's Office of Statewide Health Planning and Development (OSHPD) seismic certification of equipment. Justification for preapproval shall be based on calculations as well as physical dynamic testing.

1.05 INFORMATIONAL SUBMITTALS

- A. Source quality-control test reports.

1. Certified summary of prototype-unit test report. See requirements in Part 2 "Source Quality Control" Article Part A. Include statement indicating torsional compatibility of components.
2. Certified Test Report: Provide certified test report documenting factory test per the requirements of this specification, as well as certified factory test of generator set sensors per NFPA110 level 1.
3. List of factory tests to be performed on units to be shipped for this Project.
4. Report of exhaust emissions and compliance statement certifying compliance with applicable regulations.

B. Warranty:

1. Submit manufacturer's warranty statement to be provided for this Project.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.
- C. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.
- D. Comply with NFPA 37 (Standard For the Installation and Use of Stationary Combustion Engines and Gas Turbines).
- E. Comply with NFPA 70 (National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702).
- F. Comply with NFPA 99 (Essential Electrical Systems for Health Care Facilities).
- G. Comply with NFPA 110 (Emergency and Standby Power Systems) requirements for Level 1 emergency power supply system.

1.07 PROJECT CONDITIONS

- A. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
 1. Ambient Temperature: 15.56 deg C (60.0 deg F) to 35.0 deg C (95.0 deg F).
 2. Relative Humidity: 0 to 95 percent.

3. Altitude: Sea level to 500.0 feet (152.4 m).

1.08 WARRANTY

- A. Base Warranty: Manufacturer shall provide base warranty coverage on the material and workmanship of the generator set for a minimum of twenty-four (24) months for Standby product and twelve (12) months for Prime/Continuous product from registered commissioning and start-up.
- B. Extended Warranty: Manufacturer shall offer extend coverage of 5 years from date of registered commissioning and start-up.

PART 2 - PRODUCTS

2.01 ENGINE-GENERATOR SET

- A. Factory-assembled and -tested, engine-generator set.
- B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.
 1. Rigging Information: Indicate location of each lifting attachment, generator-set center of gravity, and total package weight in submittal drawings.
- C. Capacities and Characteristics:
 1. Power Output Ratings: Electrical output power rating for Standby operation of not less than 250.0 kW, at 80 percent lagging power factor, 277/480, Series Wye, Three phase, 4 -wire, 60 hertz.
 2. Alternator shall be capable of accepting maximum 600.0 kVA in a single step and be capable of recovering to a minimum of 90% of rated no load voltage. Following the application of the specified kVA load at near zero power factor applied to the generator set.
 3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component. The engine-generator nameplate shall include information of the power output rating of the equipment.
- D. Generator-Set Performance:
 1. Steady-State Voltage Operational Bandwidth: 0.5 percent of rated output voltage from no load to full load.
 2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 5 seconds. On application of a 100% load step the generator set shall recover to stable voltage within 10 seconds.

3. Steady-State Frequency Operational Bandwidth: 0.25 percent of rated frequency from no load to full load.
4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
5. Transient Frequency Performance: Not more than 15 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within 5 seconds. On application of a 100% load step the generator set shall recover to stable frequency within 10 seconds.
6. Output Waveform: At full load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for any single harmonic. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50.
7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 8 seconds without damage to generator system components. For a 1-phase, bolted short circuit at system output terminals, system shall regulate both voltage and current to prevent over-voltage conditions on the non-faulted phases.
8. Start Time: Comply with NFPA 110, Level 1, Type 10, system requirements.
9. Ambient Condition Performance: Engine generator shall be designed to allow operation at full rated load in an ambient temperature under site conditions, based on highest ambient condition. Ambient temperature shall be as measured at the air inlet to the engine generator for enclosed units, and at the control of the engine generator for machines installed in equipment rooms.

2.02 ENGINE

- A. Fuel: ASTM D975 #2 Diesel Fuel
- B. Rated Engine Speed: 1800RPM.
- C. Lubrication System: The following items are mounted on engine or skid:
 1. Lube oil pump: shall be positive displacement, mechanical, full pressure pump.
 2. Filter and Strainer: Provided by the engine manufacturer of record to provide adequate filtration for the prime mover to be used.
 3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

- D. Engine Fuel System: The engine fuel system shall be installed in strict compliance to the engine manufacturer's instructions
- E. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.
- F. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity and performance.
 1. Designed for operation on a single 120 VAC, Single phase, 60Hz power connection. Heater voltage shall be shown on the project drawings.
 2. Installed with isolation valves to isolate the heater for replacement of the element without draining the engine cooling system or significant coolant loss.
 3. Provided with a 24VDC thermostat, installed at the engine thermostat housing
- G. Governor: Adjustable isochronous, with speed sensing. The governing system dynamic capabilities shall be controlled as a function of engine coolant temperature to provide fast, stable operation at varying engine operating temperature conditions. The control system shall actively control the fuel rate as appropriate to the state of the engine generator. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, accelerating to rated speed, and operating in various isochronous states.
- H. Cooling System: Closed loop, liquid cooled
 1. The generator set manufacturer shall provide prototype test data for the specific hardware proposed demonstrating that the machine will operate at rated standby load in an outdoor ambient condition of 50 deg C.
 2. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
 3. Size of Radiator overflow tank: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
 4. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
 5. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.

6. Duct Flange: Generator sets installed indoors shall be provided with a flexible radiator duct adapter flange.
- I. Muffler/Silencer: Selected with performance as required to meet sound requirements of the application, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements. For generator sets with outdoor enclosures the silencer shall be inside the enclosure.
- J. Air-Intake Filter: Engine-mounted air cleaner with replaceable dry-filter element and restriction indicator.
- K. Starting System: 12 or 24V, as recommended by the engine manufacturer; electric, with negative ground.
 1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
 2. Cranking Cycle: As required by NFPA 110 for level 1 systems.
 3. Battery Cable: Size as recommended by engine manufacturer for cable length as required. Include required interconnecting conductors and connection accessories.
 4. Battery Compartment: Factory fabricated of metal with acid-resistant finish.
 5. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation. The battery charging alternator shall have sufficient capacity to recharge the batteries with all parasitic loads connected within 4 hours after a normal engine starting sequence.
 6. Battery Chargers: Unit shall comply with UL 1236, provide fully regulated, constant voltage, current limited, battery charger for each battery bank. It will include the following features:
 - a. Operation: Equalizing-charging rate based on generator set manufacturer's recommendations shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
 - b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 20 deg C to plus 40 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
 - c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.

- d. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
- e. Provide LED indication of general charger condition, including charging, faults, and modes. Provide a LCD display to indicate charge rate and battery voltage. Charger shall provide relay contacts for fault conditions as required by NFPA110.
- f. Enclosure and Mounting: NEMA, Type 1, wall-mounted cabinet.

2.03 FUEL OIL STORAGE

- A. Comply with NFPA 30.
- B. Sub Base-Mounted Fuel Oil Tank: Provide a double wall secondary containment type sub base fuel storage tank. The tank shall be constructed of corrosion resistant steel and shall be UL 142 listed and labeled. The fuel tank shall include the following features:
 - 1. Capacity: Fuel for 48 Hour(s) continuous operation at 100 percent rated power output.
 - 2. Tank rails and lifting eyes shall be rated for the full dry weight of the tank, genset, and enclosure.
 - 3. Electrical stub up(s)
 - 4. Normal & emergency vents
 - 5. Lockable fuel fill
 - 6. Mechanical fuel level gauge
 - 7. High and low level switches to indicate fuel level
 - 8. Leak detector switch
 - 9. Sub base tank shall include a welded steel containment basin, sized at a minimum of 110% of the tank capacity to prevent escape of fuel into the environment in the event of a tank rupture.
 - 10. Fill port with overfill prevention valve (OFPV)
 - 11. 5 gallon fill/spill dam or bucket
 - 12. Tank design shall meet the regional requirements for the Project location

2.04 CONTROL AND MONITORING

- A. Engine generator control shall be microprocessor based and provide automatic starting, monitoring, protection and control functions for the unit.
- B. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position,

remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. (Switches with different configurations but equal functions are acceptable.) When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of the local (generator set-mounted) and/or remote emergency-stop switch also shuts down generator set.

- C. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of the local (generator set-mounted) and/or remote emergency-stop switch also shuts down generator set.
- D. Configuration: Operating and safety indications, protective devices, system controls, engine gages and associated equipment shall be grouped in a common control and monitoring panel. Mounting method shall isolate the control panel from generator-set vibration. AC output power circuit breakers and other output power equipment shall not be mounted in the control enclosure.
- E. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 1 system, and the following:
 - 1. AC voltmeter (3-phase, line to line and line to neutral values).
 - 2. AC ammeter (3-phases).
 - 3. AC frequency meter.
 - 4. AC kW output (total and for each phase). Display shall indicate power flow direction.
 - 5. AC kVA output (total and for each phase). Display shall indicate power flow direction.
 - 6. AC Power factor (total and for each phase). Display shall indicate leading or lagging condition.
 - 7. Ammeter-voltmeter displays shall simultaneously display conditions for all three phases.
 - 8. Emergency Stop Switch: Switch shall be a red "mushroom head" pushbutton device complete with lock-out/tag-out provisions.
Depressing switch shall cause the generator set to immediately stop the generator set and prevent it from operating.
 - 9. Fault Reset Switch: Supply a dedicated control switch to reset/clear fault conditions.
 - 10. DC voltmeter (alternator battery charging).

11. Engine-coolant temperature gauge.
12. Engine lubricating-oil pressure gauge.
13. Running-time meter.
14. Generator-voltage and frequency digital raise/lower switches.
Rheostats for these functions are not acceptable. The control shall adjust these parameters in a range of plus or minus 5% of the voltage and frequency operating set point (not nominal voltage and frequency values.) The voltage and frequency adjustment functions shall be disabled when the paralleling breaker is closed.
15. Fuel tank derangement alarm.
16. Fuel tank high-level shutdown of fuel supply alarm.
17. AC Protective Equipment: The control system shall include over/under voltage, reverse kVAR, reverse kW, over load (kW) short circuit, over current, loss of voltage reference, and over excitation shut down protection. There shall be a ground fault alarm for generator sets rated over 1000 amps, overload warning, and overcurrent warning alarm.
18. Status LED indicating lamps to indicate remote start signal present at the control, existing shutdown condition, existing alarm condition, not in auto, and generator set running.
19. A graphical display panel with appropriate navigation devices shall be provided to view all information noted above, as well as all engine status and alarm/shutdown conditions (including those from an integrated engine emission control system). The display shall also include integrated provisions for adjustment of the gain and stability settings for the governing and voltage regulation systems.
20. Panel lighting system to allow viewing and operation of the control when the generator room or enclosure is not lighted.
21. Data Logging: The control system shall log the latest 20 different alarm and shut down conditions, the total number of times each alarm or shutdown has occurred, and the date and time the latest of these shutdown and fault conditions occurred.
22. DC control Power Monitoring: The control system shall continuously monitor DC power supply to the control, and annunciate low or high voltage conditions. It shall also provide an alarm indicating imminent failure of the battery bank based on degraded voltage recover on loading (engine cranking).

F. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

2.05 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Generator Overcurrent Protection: The generator set shall be provided with a UL Listed/CSA Certified protective device that is coordinated with the alternator provided to prevent damage to the generator set on any possible overload or overcurrent condition external to the machine. The protective device shall be listed as a utility grade protective device under UL category NRGU. The control system shall be subject to UL follow-up service at the manufacturing location to verify that the protective system is fully operational as manufactured. Protector shall perform the following functions:
1. Initiates a generator kW overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms.
 2. Under single phase or multiple phase fault conditions, or on overload conditions, indicates an alarm conditions when the current flow is in excess of 110% of rated current for more than 10 seconds.
 3. Under single phase or multiple phase fault conditions, operates to switch off alternator excitation at the appropriate time to prevent damage to the alternator.
 4. The operator panel shall indicate the nature of the fault condition as either a short circuit or an overload.
 5. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot greater than 120% of nominal voltage.
 6. The protective system provided shall not include an instantaneous trip function.

2.06 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1.
- B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- C. Electrical Insulation: Class H
- D. Temperature Rise: 105 / Class F environment.
- E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, over speed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- F. Permanent Magnet Generator (PMG) shall provide excitation power for optimum motor starting and short circuit performance.
- G. Enclosure: Drip-proof.

- H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified. The voltage regulation system shall be microprocessor-controlled, 3-phase true RMS sensing, full wave rectified, and provide a pulse-width modulated signal to the exciter. No exceptions or deviations to these requirements will be permitted.
- I. The alternator shall be provided with anti-condensation heater(s) in all applications where the generator set is provided in an outdoor enclosure, or when the generator set is installed in a coastal or tropical environment.
- J. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.
- K. Subtransient Reactance: 12 percent maximum, based on the rating of the engine generator set.

2.07 VIBRATION ISOLATION DEVICES

- A. Vibration Isolation: Generators installed on grade shall be provided with elastomeric isolator pads integral to the generator, unless the engine manufacturer requires use of spring isolation.
 - 1. IBC Compliance: Isolators complying with IBC requirements shall be specified in the equipment documentation, as well as the installation requirements for the unit.

2.08 FINISHES

- A. Indoor and Outdoor Enclosures and Components: Powder-coated and baked over corrosion-resistant pretreatment and compatible primer. Manufacturer's standard color or as directed on the drawings.

2.09 SOURCE QUALITY CONTROL

- A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
 - 1. Tests: Comply with NFPA 110, Level 1 Energy Converters. In addition, the equipment engine, skid, cooling system, and alternator shall have been subjected to actual prototype tests to validate the capability of the design under the abnormal conditions noted in NFPA110. Calculations and testing on similar equipment which are allowed under NFPA110 are not sufficient to meet this requirement.
- B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:

1. Test engine generator set manufactured for this Project to demonstrate compatibility and functionality.
2. Full load run.
3. Maximum power.
4. Voltage regulation.
5. Steady-state governing.
6. Single-step load pickup.
7. Simulated safety shutdowns.
8. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Comply with packaged engine-generator manufacturers' written installation, application, and alignment instructions and with NFPA 110.
- B. Equipment shall be installed by the contractor in accordance with final submittals and contract documents. Installation shall comply with applicable state and local codes as required by the authority having jurisdiction. Install equipment in accordance with manufacturer's instructions and instructions included in the listing or labeling of UL listed products.
- C. Installation of equipment shall include furnishing and installing all interconnecting wiring between all major equipment provided for the on-site power system. The contractor shall also perform interconnecting wiring between equipment sections (when required), under the supervision of the equipment supplier.
- D. Equipment shall be installed on concrete housekeeping pads. Equipment shall be permanently fastened to the pad in accordance with manufacturer's instructions and seismic requirements of the site.
- E. Equipment shall be initially started and operated by representatives of the manufacturer. All protective settings shall be adjusted as instructed by the consulting engineer.
- F. All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to initial operation and final testing of the system.
- G. On completion of the installation by the electrical contractor, the generator set supplier shall conduct a site evaluation to verify that the equipment is installed per manufacturer's recommended practice.

3.02 ON-SITE ACCEPTANCE TEST

- A. The complete installation shall be tested to verify compliance with the performance requirements of this specification following completion of all site work. Testing shall be conducted by representatives of the manufacturer, with required fuel supplied by Contractor. The Engineer shall be notified in advance and shall have the option to witness the tests. The generator set manufacturer shall provide a site test specification covering the entire system. Tests shall include:
 - B. Prior to start of active testing, all field connections for wiring, power conductors, and bus bar connections shall be checked for proper tightening torque.
 - C. Installation acceptance tests to be conducted on site shall include a "cold start" test, a two hour full load (resistive) test, and a one-step rated load pickup test in accordance with NFPA 110. Provide a resistive load bank and make temporary connections for full load test, if necessary.
 - D. Perform a power failure test on the entire installed system. This test shall be conducted by opening the power supply from the utility service, and observing proper operation of the system for at least 2 hours. Coordinate timing and obtain approval for start of test with site personnel.

3.03 TRAINING

- A. The equipment supplier shall provide training for the facility operating personnel covering operation and maintenance of the equipment provided. The training program shall be not less than 4 hours in duration and the class size shall be limited to 5 persons. Training date shall be coordinated with the facility owner.

3.04 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

3.05 SERVICE AND SUPPORT

- A. The generator set supplier shall maintain service parts inventory for the entire power system at a central location which is accessible to the service location 24 hours per day, 365 days per year. The inventory shall have a commercial value of \$3 million or more. The manufacturer of the generator set shall maintain a central parts inventory to support the supplier, covering all the major components of the power system, including

engines, alternators, control systems, paralleling electronics, and power transfer equipment.

- B. The generator set shall be serviced by a local service organization that is trained and factory certified in generator set service. The supplier shall maintain an inventory of critical power system replacement parts in the local service location. Service vehicles shall be stocked with critical replacement parts. The service organization shall be on call 24 hours per day, 365 days per year. The service organization shall be physically located within 50 of the site.
- C. The manufacturer shall maintain model and serial number records of each generator set provided for at least 20 years.

3.06 SERVICE AGREEMENT:

- A. The supplier shall include in the base price, a one-year service agreement. The maintenance shall be performed by factory authorized service technicians capable of servicing both the engine generator set and the transfer switch (es). This agreement shall include the following:
 - 1. Generator supplier must have an in-house rental fleet with equipment sized to back up this project site.
 - 2. All engine maintenance as recommended by the service manual.
 - 3. All electrical controls maintenance and calibrations as recommended by the manufacturer.
 - 4. All auxiliary equipment as a part of the emergency systems.
 - 5. The supplier shall guarantee emergency service.
 - 6. All expendable maintenance items are to be included in this agreement.
 - 7. A copy of this agreement and a schedule shall be given to the Owner at the time of his acceptance, showing what work is to be accomplished and when.

END OF SECTION

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SECTION 16260
AUTOMATIC TRANSFER SWITCHES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes transfer switches rated 600 V and less, including the following:
 1. Automatic transfer switches
 2. Bypass/isolation switches
- B. Related Sections include the following:

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.
 1. Technical data on all major components of all transfer switches and other products described in this section. Data is required for the transfer switch mechanism, control system, cabinet, and protective devices specifically listed for use with each transfer switch. Include steady state and fault current ratings, weights, operating characteristics, and furnished specialties and accessories.
 2. Single-Line Diagram: Show connections between transfer switch, bypass/isolation switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.
- B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.
 1. Dimensioned outline drawings of assembly, including elevations, sections, and details including minimal clearances, conductor entry provisions, gutter space, installed features and devices and material lists for each switch specified.
 2. Internal electrical wiring and control drawings.
 3. Interconnection wiring diagrams, showing recommended conduit runs and point-to-point terminal connections to generator set.

4. Installation and mounting instructions, including information for proper installation of equipment to meet seismic requirements.
- C. Manufacturer and Supplier Qualification Data
1. The transfer switch manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.
 2. The manufacturer of this equipment shall have produced similar equipment for a minimum period of 10 years. When requested, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Features and operating sequences, both automatic and manual.
 2. List of all factory settings of relays, timers and protective devices; provide setting and calibration instructions where applicable.
- E. Warranty documents demonstrating compliance with the project's contract requirements.

1.04 QUALITY ASSURANCE

- A. Only approved bidders shall supply equipment provided under this contract.
- B. Manufacturer Qualifications: The equipment supplier shall maintain a service center capable of providing training, parts, maintenance and emergency repairs to equipment, including transfer switch generator sets and remote monitoring equipment (if applicable) at the site within a response period of less than (eight hours or appropriate time period designated for Project) from time of notification.
1. The transfer switch shall be serviced by technicians employed by, and specially trained and certified by, the generator set supplier and the supplier shall have a service organization that is factory-certified in both generator set and transfer switch service. The supplier shall maintain an inventory of critical replacement parts at the local service organization, and in service vehicles. The service organization shall be on call 24 hours per day, 365 days per year.
 2. Submit names, experience level, training certifications, and locations for technicians that will be responsible for servicing equipment at this site.

3. The manufacturer shall maintain model and serial number records of each transfer switch provided for at least 20 years.
- C. Source Limitations: All transfer switches are to be obtained through one source from a single manufacturer. The generator set manufacturer shall warrant transfer switches to provide a single source of responsibility for products provided.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked as suitable for use in emergency, legally required or optional standby use as appropriate for the connected load.
- E. The automatic transfer switch installation and application shall conform to the requirements of the following codes and standards:
 1. Transfer switches and enclosures shall be UL 1008 listed and labeled as suitable for use in emergency, legally required, and optional standby applications.
 2. CSA 282, Emergency Electrical Power Supply for Buildings, and CSA C22.2, No. 14-M91 Industrial Control Equipment
 3. NFPA 70, National Electrical Code. Equipment shall be suitable for use in systems in compliance with Articles 700, 701 and 702.
 4. Comply with NEMA ICS 10-1993 AC Automatic Transfer Switches
 5. IEEE 446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
 6. EN55011, Class B Radiated Emissions and Class B Conducted Emissions
 7. IEC 1000-4-5 (EN 61000-4-5); AC Surge Immunity
 8. IEC 1000-4-4 (EN 61000-4-4) Fast Transients Immunity
 9. IEC 1000-4-2 (EN 61000-4-2) Electrostatic Discharge Immunity
 10. IEC 1000-4-3 (EN 61000-4-3) Radiated Field Immunity
 11. IEC 1000-4-6 Conducted Field Immunity
 12. IEC 1000-4-11 Voltage Dip Immunity
 13. IEEE 62.41, AC Voltage Surge Immunity
 14. IEEE 62.45, AC Voltage Surge Testing
- F. Comply with NFPA 99 – Essential Electrical Systems for Healthcare Facilities
- G. Comply with NFPA 110 – Emergency and Standby Power Systems. The transfer switch shall meet all requirements for Level 1 systems, regardless of the actual circuit level.

- H. The manufacturer shall warrant the material and workmanship of the transfer switch equipment for a minimum of five (5) year from the warranty start date. The warranty start date is the date of registered commissioning and start up or eighteen (18) months from date of shipment, whichever is sooner.
- I. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, and etc. during the minimum noted warranty period described above.

1.05 COORDINATION

- A. Size and location of concrete bases and anchor bolt inserts shall be coordinated. Concrete, reinforcement and formwork must meet the requirements specified in Division 03. See section "INSTALLATION" for additional information on installation
- B. If Project calls for bypass switch(es) mounted on a concrete base, the base must be designed to accommodate the requirements of the drawout mechanism (extension rails and/or wheeled carriage) of the bypass switch.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Cummins Power Generation
- B. Equipment specifications for this Project are based on automatic transfer switches manufactured by Cummins Power Generation. Switches manufactured by other manufacturers that meet the requirement of this specification are acceptable, if approved not less than two weeks before scheduled bid date. Proposals must include a line-by-line compliance statement based on this specification.
- C. Transfer switches utilizing molded case circuit breakers do not meet the requirements of this specification and will not be accepted.

2.02 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

- A. Provide transfer switches in the number and ratings that are shown on the drawings.
- B. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer.

- C. Fault-Current Closing and Withstand Ratings: UL 1008 WCR ratings must be specifically listed as meeting the requirements for use with protective devices at installation locations, under specified fault conditions. Withstand and closing ratings shall be based on use of the same set of contacts for the withstand test and the closing test.
- D. Solid-State Controls: All settings should be accurate to +/- 2% or better over an operating temperature range of - 40 to + 60 degrees C (- 40 to + 140 degrees F).
- E. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- F. Electrical Operation: Accomplished by a non-fused, momentarily energized solenoid or electric motor operator mechanism, mechanically and electrically interlocked in both directions (except that mechanical interlock is not required for closed transition switches).
- G. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
1. Switches using molded-case switches or circuit breakers, or insulated case circuit breaker components are not acceptable.
 2. Transfer switches shall be double-throw, electrically and mechanically interlocked, and mechanically held in the Source 1 and Source 2 positions.
 3. Main switch contacts shall be high pressure silver alloy. Contact assemblies shall have arc chutes for positive arc extinguishing. Arc chutes shall have insulating covers to prevent inter-phase flashover.
 4. Contacts shall be operated by a high-speed electrical mechanism that causes contacts to open or close within three electrical cycles from signal.
 5. The power transfer mechanism shall include provisions for manual operation under load with the enclosure door closed. Manual operation may be electromechanical or mechanical, but must be coordinated with control function.
 6. Transfer switch shall be provided with flame retardant transparent covers to allow viewing of switch contact operation but prevent direct contact with components that could be operating at line voltage levels.
 7. The transfer switch shall include the mechanical and control provisions necessary to allow the device to be field-configured for operating speed. Transfer switch operation with motor loads shall be as is recommended in NEMA MG1.

- a. Phase angle monitoring/timing equipment is not an acceptable substitute for this functionality
 - 8. Transfer switches designated on the drawings as "4-pole" shall be provided with a switched neutral pole switched which is switched simultaneously with phase poles.
 - 9. Transfer switches designated on the drawings as "isolation-bypass" switches shall meet the requirements of section "BYPASS/ISOLATION SWITCHES" of this specification.
- H. Control: Transfer switch control shall be capable of communicating with the genset control, other switches and remote programming devices over a high-speed network interface.
- I. Factory wiring: Transfer switch internal wiring shall be composed of pre-manufactured harnesses that are permanently marked for source and destination. Harnesses shall be connected to the control system by means of locking disconnect plug(s), to allow the control system to be easily disconnected and serviced without disconnecting power from the transfer switch mechanism
- J. Terminals: Terminals shall be pressure type and appropriate for all field wiring. Control wiring shall be equipped with suitable lugs, for connection to terminal strips.
- K. Enclosures: All enclosures shall be third-party certified for compliance to NEMA ICS 6 and UL 508, unless otherwise indicated:
1. The enclosure shall provide wire bend space in compliance to the latest version of NFPA70, regardless of the direction from which the conduit enters the enclosure.
 2. Exterior cabinet doors shall provide complete protection for the system's internal components. Doors must have permanently mounted key-type latches. Bolted covers or doors are not acceptable.
 3. Transfer switches shall be provided in enclosures that are third party certified for their intended environment per NEMA requirements.

2.03 AUTOMATIC TRANSFER SWITCHES

- A. Comply with requirements for Level 1 equipment according to NFPA 110.
- B. Indicated current ratings:
 1. Refer to the Project drawings for specifications on the sizes and types of transfer switch equipment, withstand and closing ratings, number of poles, voltage and ampere ratings, enclosure type, and accessories.
 2. Main contacts shall be rated for 600 VAC minimum.
 3. Transfer switches shall be rated to carry 100% of rated current continuously in the enclosure supplied, in ambient temperatures of -40

- to +60 degrees C (-40 to +140 degrees F), relative humidity up to 95% (non-condensing), and altitudes up to 10,000 feet (3000 meters).
- C. Manual Switch Operation: The power transfer mechanism shall include provisions for manual operation under load with the enclosure door closed. Manual operation may be electromechanical or mechanical, but must be coordinated with control function
- D. Relay Signal: Control shall include provisions for addition of a pre-transfer relay signal, adjustable from 0 to 60 seconds, to be provided if necessary for elevator operation, based on equipment provided for the project.
- E. Control: Transfer switch control shall be provided with necessary equipment and software to communicate with the genset control, other transfer switches, remote annunciation equipment, and other devices over a high speed control network.
- F. Neutral Switching: Transfer switches designated on the drawings as 4-pole shall be provided with a switched neutral pole. The neutral pole shall be of the same construction and have the same ratings as the phase poles. All poles shall be switched simultaneously using a common crossbar.
Substitute equipment using overlapping neutral contacts is not acceptable.
- G. The transfer switch physically located closest to the generator and not more than 50 ft (15 meters) away, except those served by generator paralleling equipment, shall be provided with a battery charger suitable for the requirements of the application and in compliance with NFPA 110 requirements for Level 1 systems. If no transfer switch is located within this distance, a battery charger shall be installed on the generator set.
- H. Automatic Transfer Switch Control Features
1. The transfer switch control system shall be configurable in the field for any operating voltage level up to 600 VAC. Voltage sensing shall be monitored based on the normal voltage at the site. Systems that utilize voltage monitoring based on standard voltage conditions that are not field configurable are not acceptable.
 2. All transfer switch sensing shall be configurable from an operator panel or from a Windows XP or later PC-based service tool. Designs utilizing DIP switches or other electromechanical devices are not acceptable.
 3. The transfer switch shall be configurable to accept a relay contact signal and a network signal from an external device to prevent transfer to the generator service.
 4. The transfer switch shall provide a relay contact signal prior to transfer or re-transfer. The time period before and after transfer shall be adjustable in a range of 0 to 60 seconds.

5. The control system shall be designed and prototype tested for operation in ambient temperatures from - 40 degrees C to + 60 degrees C (- 40 to +140 degrees F). It shall be designed and tested to comply with the requirements of the noted voltage and RFI/EMI standards.
 6. The control shall have optically isolated logic inputs, high isolation transformers for AC inputs and relays on all outputs, to provide optimum protection from line voltage surges, RFI and EMI.
 7. The transfer switch network monitoring equipment, when supplied, shall be provided with a battery-based auxiliary power supply to allow monitoring of the transfer switch when both AC power sources are non-operational.
- I. Transfer Switch Control Panel: The transfer switch shall have a microprocessor-based control with a sealed membrane panel incorporating pushbuttons for operator-controlled functions, and LED lamps for system status indicators. The panel shall also include an alphanumeric display for detailed system information. Panel display and indicating lamps shall include permanent labels.
1. The indicator panel LEDs shall display:
 - a. Which source the load is connected to (Source 1 or Source 2)
 - b. Which source or sources are available
 - c. When switch is not set for automatic operation, the control is disabled or the bypass switch is in use
 - d. When the switch is in test/exercise mode
 2. The indicator shall have pushbuttons that allow the operator to activate the following functions:
 - a. Activate pre-programmed test sequence
 - b. Override programmed delays, and immediately go to the next operation
 - c. Reset the control by clearing any faults
 - d. Test all of the LEDs by lighting them simultaneously
 3. The alphanumeric digital display shall be vacuum fluorescent-type, clearly visible in both bright sunlight and no-light conditions over an angle of 120 degrees, and shall display the following:
 - a. AC voltage for all phases, normal and emergency
 - b. Source status: connected or not connected.
 4. The display panel shall be password-protected, and allow the operator to view and make adjustments:
 - a. Set nominal voltage and frequency for the transfer switch
 - b. Adjust voltage and frequency sensor operation set points
 - c. Set up time clock functions
 - d. Set up load sequence functions
 - e. Enable or disable control functions including program transition

- f. View real-time clock data, operation log (hours connected, times transferred, failures) and service history

J. Control Functions: Functions managed by the control shall include:

1. Software adjustable time delays:
 - a. Engine start (prevents nuisance genset starts in the event of momentary power fluctuation): 0 to 120 seconds (default 3 sec)
 - b. Transfer normal to emergency (allows genset to stabilize before load is transferred): 0 to 120 seconds (default 3 sec)
 - c. Re-transfer emergency to normal (allows utility to stabilize before load is transferred from genset): 0 to 30 minutes (default 3 sec)
 - d. Engine cooldown: 0 to 30 minutes (default 10 min)
 - e. Programmed transition: 0 to 60 seconds (default 3 sec)
2. Undervoltage sensing: three-phase normal, three-phase emergency source.
3. Over-voltage sensing: three-phase normal, three-phase emergency source.
4. Over/under frequency sensing:
 - a. Pickup: +/- 5 to +/-20% of nominal frequency (default 10%)
 - b. Dropout: +/-1% beyond pickup (default 1%)
 - c. Dropout time delay: 0.1 to 15.0 seconds (default 5 sec)
 - d. Accurate to within +/- 0.05 Hz
5. Voltage imbalance sensing:
 - a. Dropout: 2 to 10% (default 4%)
 - b. Pickup: 90% of dropout
 - c. Time delay: 2.0 to 20 seconds (default 5 sec)
 - d. Bar graph meter panel, to display 3-phase AC Amps, 3-phase AC Volts, Hz, KW load level, and load power factor. The display shall be color-coded, with green scale indicating normal or acceptable operating level, yellow indicating conditions nearing a fault, and red indicating operation in excess of rated conditions for the transfer switch.
6. Phase rotation sensing:
 - a. Time delay: 100 msec
7. Loss of single-phase detection:
 - a. Time delay: 100 msec

K. Control features shall include:

1. Programmable genset exerciser: A field-programmable control shall periodically start and run the generator with or without transferring the load for a preset time period, then re-transfer and shut down the generator after a preset cool-down period.
2. In event of a loss of power to the control, all control settings, real-time clock setting and the engine start-time delay setting will be retained.

3. The system continuously logs information including the number of hours each source has been connected to the load, the number of times transferred, and the total number of times each source has failed. An event recorder stores information, including time and date-stamp, for up to 50 events.
4. Re-Transfer Inhibit Switch: Inhibits automatic re-transfer control so automatic transfer switch will remain connected to emergency power source as long as it is available regardless of condition of normal source.
5. Transfer Inhibit Switch: Inhibits automatic transfer control so automatic transfer switch will remain connected to normal power source regardless of condition of emergency source.

L. Control Interface

1. Provide one set Form C auxiliary contacts on both sides, operated by transfer switch position, rated 10 amps 250 VAC.
2. The transfer switch shall be provided with a network communication card, and configured to allow network-based communication with the transfer switch and other network system components, including the generator set(s) provided for the Project.

M. Engine Starting Contacts

1. One isolated and normally closed pair of contacts rated 10A at 32 VDC minimum.

2.04 BYPASS/ISOLATION SWITCHES

- A. Comply with requirements for Level 1 equipment according to NFPA 110.
- B. Description: Transfer switches that are designated on the drawings as "bypass isolation" transfer switches shall be provided with a manually-operated bypass switch arranged to select and connect either source of power directly to load, isolating transfer switch from load and from both power sources. Include the following features for each combined automatic transfer switch and bypass/isolation switch:
 1. The bypass switch shall be enclosed in the same cabinet as the automatic transfer switch, and UL-listed as an assembled product.
 2. The bypass isolation switch shall provide a means for manually bypassing the transfer switch from either source (Normal or Emergency) to the load, while under load if necessary, and to isolate the transfer switch from both sources for maintenance or repair without a power interruption or disturbance.
 - a. Designs that bypass to only one source are not acceptable under this specification.

3. The bypass switch shall be operable without the use of tools, and shall include the ability to isolate the automatic switch mechanism without the use of tools and without opening the exterior cabinet door(s).
4. Operability: Switch shall be constructed so load bypass and transfer-switch isolation can be performed by one person in no more than two operations, in 15 seconds or less.
5. Bypass isolation switch equipment shall be UL listed per Standard 1008 and CSA approved, with continuous current rating, voltage and frequency ratings, and withstand and closing ratings equal to the transfer switch ratings at the specified conditions of ambient temperature, humidity, and altitude.
6. The bypass isolation and transfer switches shall be mechanically held in each position. Switching mechanisms shall be break-before-make on all poles, including the neutral pole on 4-pole switches except where closed transition transfer is specified as defined in section "CLOSED-TRANSITION TRANSFER SWITCHES". The switch mechanism shall be an over-center toggle device which provides stored energy contact operation during both opening and closing. The speed of contact operation shall be independent of the force applied to the operating handles, which permit manual operation under load.
7. Provide means to lock bypass/isolation switch in the position that isolates transfer switch with an arrangement that permits complete electrical testing of transfer switch while isolated. While isolated, interlocks shall prevent transfer-switch operation, except for testing or maintenance.
8. Bypass switch shall be a fully-rated, manually-operated switch, rated for the same loads as the automatic transfer switch. Bypass switch shall provide bypass to either normal or emergency source by use of a door mounted, keyed source selector switch and a permanently mounted external operating handle. Equipment shall provide manual bypass without disturbance of the power supply to the load.
 - a. Equipment requiring load isolation before bypass is not acceptable for use on this Project.
9. Maintainability: Fabricate to allow convenient removal of major components from front without removing other parts or main power conductors.
10. Contact temperatures of bypass/isolation switches shall not exceed those of automatic transfer-switch contacts when they are carrying rated load.
11. Positive mechanical interlocks shall prevent all possible source-to-source interconnections via the bypass switch. The interlock system shall assure a properly sequenced, mechanically guided bypass and isolation action.

- a. Designs which depend on electrical interlocks to prevent source to source interconnections, or which intentionally interconnect the sources via the bypass switch, are not acceptable.
 - 12. The equipment shall utilize automatic, mechanical stops to prevent manually bypassing to a dead source.
 - a. Equipment that does not prevent dead source bypass is not acceptable.
 - 13. A drawout isolation mechanism shall provide closed-door isolation of the transfer switch. The isolation mechanism shall be interlocked so that either the transfer switch must be bypassed or the transfer switch must be open before the mechanism will permit isolation of the transfer switch. Drawout arrangement must provide physical separation from live parts and accessibility for testing and maintenance operations.
 - 14. The isolation mechanism shall provide for three-position operation: Connected, Test, and Isolated. In the Connected position, isolation contacts shall be fully engaged and closed, with the transfer switch control cable connected. In the Test position, isolation contacts shall be open and the transfer switch control cable connected. The Test position shall allow operational testing of transfer switches and controls without power disruption to the load. In the Isolated position, the transfer switch and control shall be completely isolated from all power sources. In the Isolated position, the transfer switch shall be capable of being withdrawn from the cabinet.
 - 15. The bypass and isolation process for the automatic transfer switch shall be capable of being fully accomplished without opening the cabinet door.
 - 16. Interconnection of bypass/isolation switch with automatic transfer switch shall consist of factory-installed copper bus bars, plated at connection points and braced for the indicated available short-circuit current.
 - 17. Note the size and access requirements for the transfer switch with bypass isolation and provide equipment that will fit into the space allowed as well as complying with code-specified access requirements.
 - 18. Manufacturer's standard legend for control labels and instruction signs shall describe operating instructions.
- C. Interconnection of Bypass/Isolation Switches with Automatic Transfer Switches: Factory-installed copper bus bars, plated at connection points and braced for the indicated available short-circuit current.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Design each fastener and support to carry load indicated by seismic requirements and according to seismic-restraint details. See Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- B. Floor-Mounting Switch: Anchor to floor by bolting.
 - 1. Floor-mounted transfer switches (except drawout switches supported by wheeled carriages, which must be rolled out at floor level) shall be mounted on concrete bases complying with the following requirements:
 - a. Concrete Bases: 4 inches (100 mm) high, reinforced, with chamfered edges. Extend base no more than 4 inches (100 mm) in all directions beyond the maximum dimensions of switch, unless otherwise indicated or unless required for seismic support. Construct concrete bases according to Division 26 Section "Hangers and Supports for Electrical Systems."
- C. Annunciator Panel Mounting: Flush in wall, unless otherwise indicated.
- D. Identify components according to Division 26 Section "Identification for Electrical Systems."
- E. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.02 CONNECTIONS

- A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.
- B. Field control connections shall be made on a common terminal block that is clearly and permanently labeled.
- C. Transfer switch shall be provided with AL/CU mechanical lugs sized to accept the full output rating of the switch. Lugs shall be suitable for the number and size of conductors shown on the drawings.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.03 SOURCE QUALITY CONTROL

- A. Prior to shipping, factory shall test and inspect components, assembled switches, and associated equipment to ensure proper operation.
- B. Factory shall check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements.
- C. Factory shall perform dielectric strength test complying with NEMA ICS 1.

3.04 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: The supplier of the transfer switch(es) and associated equipment shall inspect, test, and adjust components, assemblies, and equipment installations, including connections, and report results in writing.
- B. Manufacturer's representative shall perform tests and inspections and prepare test reports.
- C. After installing equipment and after electrical circuitry has been energized, installer shall test for compliance with requirements.
 1. Perform recommended installation tests as recommended in manufacturer's installation and service manuals.
 2. After energizing circuits, demonstrate interlocking sequence and operational function for each switch.
 - a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
 - b. Verify time-delay settings.
 - c. Verify that the transfer switch is accurately metering AC voltage.
 - d. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
 - e. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
- D. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
 1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
 2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 3. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include

notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.05 DEMONSTRATION

- A. After generator set installation, the generator and transfer switch supplier shall conduct a complete operation, basic maintenance, and emergency service seminar covering generator set and transfer switch equipment, for up to 10 people employed by the Owner.
 1. The seminar shall include instruction on operation of the transfer equipment, normal testing and exercise, adjustments to the control system, use of the PC based service and maintenance tools provided under this contract, and emergency operation procedures.
 2. The class duration shall be at least 8 hours in length, and include practical operation with the installed equipment.

3.06 SERVICE AND SUPPORT

- A. The manufacturer shall supply the Service Provider with a complete set of the service and maintenance software required to support the product. The software shall be provided at a training class attended by the user, to qualify the user in proper use of the software. The software shall have the following features and capabilities:
 1. The software shall allow adjustment of all functions described herein, adjustment of operating levels of all protective functions, and programming of all optional functions in the controller. Adjustments shall be possible over modem from a facility that is remote from the generator set.
 2. The software shall be capable of storing and displaying data for any function monitored by the generator set control. This data shall be available in common file formats, and on graphical "strip chart" displays.
 3. The software shall automatically record all control operations and adjustments performed by any operator or software user, for tracking of changes to the control.
 4. The software shall display all warning, shutdown, and status changes programmed into transfer switch controller. For each event, the control shall provide information on the nature of the event, when it last occurred, and how many times it has occurred.

END OF SECTION

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SECTION 16402
UNDERGROUND ELECTRICAL WORK

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Provisions: Applicable provisions of Section 16010 become a part of this Section as if repeated herein.

1.02 APPLICABLE STANDARDS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.
1. Federal Specifications (Fed. Spec.):
 - a. RR-F-621C Frames, Covers, Gratings, Steps, Sump and Catch Basin, Manhole
 - b. RR-G-661D Grating, Metal, Bar Type (Floor, except for Naval Vessels)
 2. American Concrete Institute (ACI) Publication:
 - a. 318 Building Code Requirements for Reinforced Concrete
 3. ASTM International (ASTM) Publications:
 - a. A36 Structural Steel
 - b. A153 Specifications for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - c. A615 Deformed and Plain Billet - Steel Bars for Concrete Reinforcement
 - d. C33 Concrete Aggregates
 - e. C139 Concrete Masonry Units for Construction of Catch Basins and Manholes, Specification for
 - f. C150 Portland Cement
 - g. C478 Precast Reinforced Concrete Manhole Sections, Specification for
 - h. C857 Recommended Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
 - i. C858 Standard Specification for Underground Precast Concrete Utility Structures
 4. American Association of State Highway and Transportation Officials (AASHTO) Publication:
 - a. HB-13 Standard Specifications for Highway Bridges
 5. American National Standard Institute (ANSI) Publication:
 - a. C2 National Electrical Safety Code
 6. National Fire Protection Association (NFPA) Publication:
 - a. 70 National Electrical Code (NEC)

1.03 SUBMITTALS

- A. Submit material or equipment data in accordance with General Conditions Section 5 and the submittal requirements of Section 16010.
- B. Manufacturer's Data and Shop Drawings:
 - 1. Handhole - Include a table of dimensions which shows proposed size of each handhole.
 - 2. Handhole frame and cover
 - 3. Sealing material for precast handhole joints
- C. Certificates:
 - 1. Test Reports: Submit for approval 30 days before the materials are used, copies of laboratory test reports for the following:
 - a. Arc-proofing test for cable fireproofing materials

PART 2 - PRODUCTS

2.01 GENERAL

- A. Materials and equipment shall conform to the respective specifications and standards and to the specifications herein. Electrical ratings shall be as indicated.
- B. Conduit: Provide per Section 16110.
- C. Wire and Cable: Provide per Section 16120 and Section 16124.

2.02 CAST-IN-PLACE AND PRECAST MANHOLES

- A. Cast-in-place concrete manholes shall have a smooth trowel finish for floors and horizontal surfaces. Concrete shall conform to Division 3, Section 03300. Precast concrete manholes, risers and tops shall conform to ASTM C478, except that the spacing of manhole steps or ladder rungs shall not exceed 16 inches. Precast units (ACI 318) shall be the product of a manufacturer regularly engaged in the manufacture of precast concrete manholes and handholes. Manholes shall be the type noted on the Drawings and shall be constructed in accordance with the applicable details as indicated. Top, walls, and bottom shall consist of reinforced concrete. Walls, bottom, and top of manholes shall be of monolithic concrete construction; sectionalized construction is not acceptable. Duct entrances and windows shall be located near the corners of structures to facilitate cable racking. Covers shall fit the frames without undue play. Steel and iron shall be formed to shape and size with sharp lines and angles. Castings shall be free from warp and blow holes that may impair their strength or appearance. Exposed metal shall have a smooth finish and sharp lines and arises. Provide all necessary lugs, rabbets, and brackets. Set pulling-in iron shall be installed in the wall opposite each

duct line entrance. The words "ELECTRICAL" shall be cast in the top face of all manhole covers. Cable racks, including rack arms and insulators, shall be adequate to accommodate the cable. Cable racking hardware shall be non-metallic and corrosion resistant as manufactured by Pacific Utilities Supply, or approved substitute.

- B. Metal Frames, Covers, and Gratings: Provide steel or malleable iron frames, covers, and gratings conforming to Federal Specification RR-G-661, Type I.
- C. Complete manholes shall be rated for HS 20-44 wheel loading as given in AASHTO HB-13.

2.03 HANDHOLES

- A. Provide handholes of reinforced precast concrete, or injection molded composite plastic material. Handholes shall include a base, a body, extensions, and a cover. Handholes with a perimeter of 10 feet or more (e.g., 3 feet by 2 feet) shall have both pulling irons and cable racks. All hardware shall be stainless steel, or hot-dip galvanized after fabrication; cable racking hardware, however, shall be non-metallic and corrosion resistant. If no handhole size is shown on the Drawings, size units per NEC or provide 12 inches by 24 inches by 18 inches deep, whichever is larger. Structure shall be fabricated in accordance with ACI 318.
- B. Aggregate used in pre-cast handholes shall conform to the specifications given in ASTM C33.
- C. Cement used shall be Type 11, low alkali Portland cement and shall meet ASTM C150, Type 11.
- D. Reinforcing bars shall be intermediate grade billet steel conforming to ASTM A615.
- E. Design wheel loads for handhole covers shall be HS 20-44 as given in AASHTO HB-13.

PART 3 - EXECUTION

3.01 TRENCHING, BACKFILL, AND COMPACTION

- A. See Division 2.

3.02 WIRE AND CABLE INSTALLATION

- A. See Section 16120 and Section 16124.

3.03 UNDERGROUND RACEWAYS WITH CONCRETE ENCASEMENT

- A. All underground raceways shall be encased in concrete unless otherwise specifically shown otherwise on the Drawings.
 1. Concrete encasement shall be minimum of 3 inches around outer walls of raceways and minimum of 2 inches between raceways. Conduits shall be PVC.
 2. Concrete shall be Portland cement type with 4 sacks cement per cubic yard of concrete, maximum coarse aggregate size of 3/8 inches and shall have minimum strength of 2,000 psi after 28 days. Amount of water shall not exceed slump required for placement. Five pounds red lead oxide shall be added per cubic yard of concrete for medium voltage raceway encasement only.
 3. Underground raceways shall slope toward manholes, pull boxes, etc., at minimum rate of 3 inches per 100 feet unless indicated otherwise on the Drawings. Raceway entrances in manholes, handholes, etc., shall be by means of bell ends and shall be sealed against entry of silt, debris, rodents, etc., into raceways.
 4. Top of concrete encasement shall be minimum of 24 inches below grade.
 5. Minimum radius of all horizontal bends in underground duct banks shall be 25 feet. Bends shall be formed of factory made sweeps or continuous assembly of bend segments or curved segments, except that polyvinyl chloride conduits may be field formed. Minimum radius of all vertical bends in underground raceways shall be ten times nominal size of conduit. Vertical bends shall be made of rigid steel or permanently coated aluminum conduit.
 6. Underground raceways within roadways shall be run parallel or perpendicular to road centerline.
 7. Pull wires left in underground raceways shall be 1/8-inch nylon rope or 3/16-inch polypropylene.
 8. Terminate conduits in end-bells where duct lines enter manholes and handholes. Provide structural support for concrete encased duct banks at the point where they terminate. Separators shall be of precast concrete, high impact polystyrene, steel, or any combination of these. Stagger the joints of the conduits by rows and layers so as to provide a duct line having the maximum strength. During construction, protect partially completed duct lines from the entrance of debris such as mud, sand and dirt by means of suitable conduit plugs. As each section of a duct line is completed, draw a brush through having the diameter of the duct, and having stiff bristles until the conduit is clear of all particles of earth, sand, and gravel; then immediately install conduit plugs.
- B. Connections to Existing Ducts: Where connections to existing duct lines are indicated, excavate the lines to the maximum depth necessary. Cut off the lines and remove loose concrete from the conduits before new concrete encased ducts are installed. Provide a reinforced concrete collar, poured

monolithically with the new duct line, to take the shear at the joint of the duct lines. Remove existing cables that constitute interference with the work. Abandon in place those used ducts and cables that do not interfere with the work.

- C. Removal of Ducts: Where duct lines are removed from existing manholes, close the openings to waterproof the manhole. Chip out the wall opening to provide a key for the new section of wall.
- D. See Section 16110 for additional requirements.

3.04 UNDERGROUND RACEWAYS WITHOUT CONCRETE ENCASEMENT

- A. Provide raceways without concrete encasement only if specifically shown on the Drawings, otherwise, provide concrete encasement as above.
- B. Provide sand backfill 3 inches all around the raceway.
- C. Construct raceways per the applicable provisions above for underground raceways with concrete encasement.
- D. See Section 16110 for additional requirements.

3.05 HANHOLES

- A. Provide handholes complete with all accessories, as indicated. Identify each casting by having the manufacturer's name cast into an interior face or permanently attached thereto.

END OF SECTION

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SECTION 16450
ELECTRICAL GROUNDING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Provisions: Applicable provisions of Section 16010 become a part of this Section as if repeated herein.
- B. Work Included: Furnish all labor, material, equipment, tools and services necessary for the installation, connection and testing of all grounding as specified herein and as shown on the Drawings.

1.02 REFERENCE STANDARDS

- A. ASM International (ASTM) Publication:
 - 1. B228 Copper Clad Steel Conductors Specification
 - 2. D178 Specifications for Rubber Insulating Matting
- B. National Fire Protection Association (NEPA):
 - 1. 70 National Electric Code (NEC)
- C. International Electrical Testing Association (NETA) Publication:
 - 1. ATS Acceptance Testing Specifications for Electrical Equipment for Power Systems

1.03 SUBMITTALS

- A. Submit material or equipment data in accordance with General Conditions Section 5 and the submittal requirements of Section 16010.

PART 2 - PRODUCTS

2.01 GENERAL

- A. 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 Drawings.

2.02 SYSTEM COMPONENTS

- A. 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% of pure copper. Rods shall be

not less than $\frac{3}{4}$ inch in diameter and 10 feet long, unless otherwise indicated. Rods longer than 10 feet shall be made up of 10-foot units joined together with threaded couplings. The manufacturer's trademark shall be stamped near the top.

- B. **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.
- C. **Ground Connections:** Connection to ground rods and buried connections shall be by exothermic weld. Lugs for attachment of cables to steel enclosures shall be of the binding post type with a 1/2-13NC stud. Each post shall accommodate cables from #4 AWG to #2/0 AWG.
- D. **Ground Rod Boxes:** Boxes shall be a 9-inch-diameter precast concrete unit with hot-dip galvanized traffic covers. Units shall be 12 inches deep. Covers shall be embossed with the wording "Ground Rod."
- E. **Ground Bus:** Ground bus shall be a high conductivity copper alloy strap measuring 3/16 inch by 3/4 inch and of lengths as shown on the Drawings. Bus shall be predrilled and tapped to accept 8-32 brass machine screws on 12-inch centers.

2.03 RUBBER MATS

- A. Provide corrugated rubber mats, which conform to ASTM D178 Type II, oil resistant. Mats for low voltage switchboards and switchgear and motor control centers shall be rated for protection for 1,000 volts minimum to ground. Mats for medium voltage switchgear shall be rated 17,000 volts.
- B. Mat shall be a minimum of 1/4 inch thick and black in color with beveled edges. Mats shall extend the full width of the equipment with a minimum width of 30 inches. Mats shall be 4 feet deep in front of low voltage equipment and 6 feet deep in front of medium voltage equipment.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Ground all equipment for which a ground connection is required per NEC whether or not the ground connection is specifically shown on the Drawings.

- B. Provide a ground rod box for each ground rod so as to permit ready access for the connection and/or removal of any pressure connectors to facilitate testing.
- C. Where ground rods must be driven to depths over 8 feet, increase rod diameter used, sufficiently to prevent the rod from bending or being damaged.
- D. Bond metallic water piping at its entrance into each building. Ground separately derived electrical system neutrals to the metallic water piping in addition to the system driven ground, per NEC requirements.
- E. Provide a ground wire in every conduit carrying a circuit of over 150 volts to ground.
- F. Make embedded or buried ground connections, taps and splices with exothermic welds. Coat ground connections.
- G. Effectively bond structural steel for buildings to the grounding system using exothermic welds.
- H. Install rubber mats in front of low voltage switchboards and switchgear, medium voltage switchgear, and motor control centers.

3.02 TESTING

- A. Perform testing per NETA Standard ATS paragraph 7.3. Test methods shall conform to NETA Standard ATS using the three electrode. Conduct tests only after a period of not less than 48 hours of dry weather.
- B. Furnish to the Officer-in-Charge a test report with recorded data of each ground rod location.
- C. Furnish a separate report on the rubber mats. Make measurements in conformance with manufacturer's instructions.

END OF SECTION

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SECTION 16460
DRY TYPE TRANSFORMERS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Provisions: Applicable provisions of Section 16010 become a part of this Section as if repeated herein.

1.02 REFERENCE STANDARDS

- A. American National Standards Institute (ANSI) Publications:
1. 70 National Electrical Code
 2. C2 National Electrical Safety Code
- B. National Electrical Manufacturers Association (NEMA) Publication:
1. ST 20 Dry-Type Transformers for General Applications

1.03 SUBMITTALS

- A. Submit material or equipment data in accordance with the Product Review category of the General Conditions and the submittal requirements of Section 16010.
- B. Shop Drawings: Submit manufacturer's name and data as required:
1. Nameplate Data:
 - a. kVA rating.
 - b. Nominal primary voltage.
 - c. Tap voltages.
 - d. Nominal secondary voltage.
 - e. Percent impedance.
 - f. Weight.
 - g. Physical dimensions and mounting requirements.
 2. Single Submittal: A single complete submittal is required for all products covered by this Section.
- C. Submit seismic design certifications and anchorage descriptions as required by Section 01190.

1.04 FACTORY TESTING

- A. Tests on transformers shall include the manufacturer's standard tests, including winding resistance, ratio, polarity, phase relation, no-load loss,

impedance, full load losses, and dielectric tests. Certified copies shall show compliance with all referenced standards.

1.05 LOCATIONS

- A. Refer to Section 16010 for definitions of types of locations.

PART 2 - PRODUCTS

2.01 DRY TYPE TRANSFORMERS

- A. General Purpose: Transformers for supplying lighting and small power loads shall be dry type, general purpose, two winding, 60 Hertz, copper windings, temperature rise not exceeding 80°C under full load in an ambient of 40°C with Class H, 220°C insulation. Capacity ratings and voltages shall be as shown on the Drawings. Transformers shall comply with all applicable provisions of NEMA Standard ST20 and shall have NEMA Standard taps. Transformers shall be indoor type with sound levels 5 dB below NEMA Standard or outdoor type with NEMA Standard sound levels. Terminal compartment shall have a temperature rise not to exceed 35°C. Outdoor units shall be equipped with weather shields. Transformers 30 kVA and larger, 3 phase, shall be energy efficient type.

PART 3 - EXECUTION

3.01 TRANSFORMER INSTALLATION

- A. Transformers shall be installed as indicated on the Drawings.
- B. Transformers shall be connected with flexible, liquid-tight metallic conduit to prevent the transmission of sound through the conduit system. Potted non-ventilated types below 30 kVA shall be installed on resilient vibration-isolating mountings.
- C. Transformer grounding shall be sized in accordance with NEC requirements for separately derived systems and shall be connected to the nearest cold water pipe or, if available, structural steel member. Ground rod and connections shall be as detailed in Section 16450. Provide conduit and wire for both the ground rod and cold water pipe or structural steel member connections.
- D. Lace secondary conductors to resist short circuit forces. Follow manufacturer's recommendations.

3.02 FIELD TESTS

- A. Test per NETA Paragraph 8.2.3. Submit results for review.

END OF SECTION

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SECTION 16500

LIGHTING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Provisions: Applicable provisions of Section 16010 become a part of this Section as if repeated herein.
- B. Work Included: Provide a lighting system complete, including fixtures, standards, bases, hangers, reflectors, lenses, auxiliary equipment.

1.02 REFERENCE STANDARDS

- A. Federal Regulations
 - 1. Title 21 Performance Standards for Light Emitting Products CFR 1040
- B. Underwriters Laboratories, Inc. (UL) Standards
 - 1. 57 Electric Lighting Fixtures
 - 2. 844 Electric Lighting Fixtures for Use in Hazardous (Classified) Locations

1.03 SUBMITTALS

- A. Submit material or equipment data in accordance with General Conditions Section 5 and the submittal requirements of Section 16010.
- B. Submit photometric curves for each fixture configuration proposed. Substitutions will not be considered unless the photometric distribution curve indicates the proposed fixture is equal to or exceeds the specified luminaire.
- C. Submit shop drawings showing proposed methods for mounting interior lighting fixtures which are not attached directly to the ceiling or wall.
- D. Submit seismic design certifications and anchorage descriptions as required by Section 01190.

1.04 GUARANTEE

- A. LED Fixtures which fail within 90 days after acceptance by the Officer-in-Charge shall be replaced at no cost to the City.

PART 2 - PRODUCTS

2.01 FIXTURES

- A. Fixtures shall be of the types, wattages and voltages shown on the Drawings, be UL classified and labeled for intended use. Fixtures for use in hazardous locations shall be UL listed per UL Standard 844.
- B. Luminaire wire, and the current carrying capacity thereof, shall be in accordance with the NEC.
- C. Luminaires and lighting equipment shall be delivered to the project site complete, with suspension accessories, frames, recessing boxes and related items, including supports and braces.

2.02 LAMP DRIVER

- A. Lamp Driver: Driver shall bear the UL label.
- B. Ballasts producing excessive noise (above 36 dB) or vibration will be rejected and shall be replaced at no cost to the City.

2.03 LAMP POSTS AND STANDARDS

- A. Lamp posts and standards shall be of the type, configuration, and dimensions shown on the Drawings, and shall be suitable for the indicated lamp mounting height.
- B. Furnish complete with anchor bolts, bolt circle template, hand holes, and cover plate.

2.04 EMERGENCY FIXTURES

- A. General: Fixture enclosures shall consist of an injection molded, high impact, NEMA 4X gasketed corrosion resistant reinforced polyester fiberglass housing. All hardware shall be stainless steel.
- B. Emergency power shall be automatically supplied to light sources from sealed nickel metal hydride or spiral wound pure lead batteries with a life expectancy rating of 15 years. Units shall comply with all requirements of UL 924.
- C. Electronic solid-state logic shall provide 20 millisecond switching, automatic power cutoff at 87-1/2% cell voltage, recharging of batteries within 12 hours, and pilot light indication of battery and charger conditions. A manual test switch shall be provided to allow checking equipment function.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:

1. All fixtures and luminaires shall be clean and lamps shall be operable at the time of acceptance.
2. Install luminaires in accordance with manufacturer's instructions, complete with lamps, ready for operation as indicated.
3. Align, mount, and level the luminaires uniformly.
4. Avoid interference with and provide clearance for equipment. Where an indicated position conflicts with equipment locations, change the location of the luminaire by the minimum distance necessary.

B. Mounting and Supports:

1. Mounting heights shall be as shown on the Drawings. Unless otherwise shown, mounting height shall be measured to the centerline of the outlet box for a wall mounted fixture and to the bottom of the fixture for all other types.
2. For suspended luminaires, the mounting heights shall provide clearances between the bottoms of the luminaires and the finished floors as indicated.
3. Luminaire supports shall be anchored to the structural slab or structural members as indicated.
4. Surface mounted fixtures shall be rigidly bracketed from mounting surfaces. Luminaires installed in rows shall have a non-cumulative dimensional alignment tolerance of 1/16 inch. Nipples carrying wiring between luminaires shall be watertight.

C. Mount lamp posts and lighting standards plumb and make free of dents or other damage.

D. Concrete Bases:

1. Templates and anchor bolts shall be obtained before starting any work.
2. Concrete bases shall be constructed in accordance with Section 03300.

E. Battery Operated Emergency Lighting Fixtures:

1. Battery disconnect switch to be left in the "off" position until building power is fully operational.

END OF SECTION

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SECTION 16924

VARIABLE FREQUENCY DRIVES (VFD) OVER 5 HORSEPOWER

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Applicable provisions of Section 16010 become a part of this Section as if repeated herein.
- B. Work Included: Provide a VFD controller for each of those motors so shown on the Drawings.
- C. Related Work Specified Elsewhere:
 - 1. Section 11002: Electric Motor Drives
 - 2. Section 16955: Control Devices

1.02 REFERENCE STANDARDS

- A. National Electrical Manufacturers Association (NEMA) Publications:
 - 1. ICS 1 General Standards for Industrial Controls and Systems
 - 2. ICS 2 Standards for Industrial Control Devices, Controllers and Assemblies
 - 3. ICS 3 Industrial Systems
 - 4. ICS 3.1 Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-speed Drive Systems
 - 5. ICS 4 Terminal Blocks for Industrial Control Equipment and Systems
 - 6. ICS 6 Enclosures for Industrial Controls and Systems
- B. American National Standards Institute (ANSI) Publication:
 - 1. C37.90 Relays and Relay Systems Associated with Electric Power Apparatus
- C. Institute of Electrical and Electronic Engineers (IEEE) Publication:
 - 1. 519 Harmonic Control and Reactive Compensation of Static Power Converters

1.03 SUBMITTALS

- A. Submit material or equipment data in accordance with General Conditions Section 5 and the submittal requirements of Section 16010.
- B. Submit shop drawings, including: complete elementary (ladder) diagrams; comprehensive interconnection diagrams for VFD, motor, external control devices and controllers, and other related devices; drawings showing

physical arrangement of components; front elevation to scale with overall dimensions, conduit entrance spaces and weights; and Bill of Materials.

- C. Submit written descriptions explaining ladder diagram operation, system operation and analog signal processing.
- D. Submit comprehensive interconnection diagrams for VFD, motor wet well level controller, and other related devices.
- E. Within 45 days following Notice to Proceed:
 - 1. Submit a report documenting the results of computer or factory based voltage distortion and commutation notch area simulations. Obtain all data needed for the report. Contact equipment manufacturers to obtain impedance and fault duty data. Obtain other data from the field as necessary. The simulations shall model the effects of full load VFD operation on the line side of the VFD during both utility and standby generator operation. Simulations shall demonstrate compliance with IEEE 519 for general systems.
 - 2. If simulations show that compliance with IEEE 519 cannot be achieved with the equipment shown on the Drawings, include in the report the manufacturer's recommended design modifications needed to ensure compliance with IEEE 519. Include additional simulation data for the recommended system demonstrating compliance. Simulation shall include specific filtering or impedance modifications necessary. Perform and submit a report on the results of a power factor analysis and document any special switching requirements necessary to eliminate filter induced leading power factors.
 - 3. Submit sketches of the revised single line diagram and a revised scale drawing of the equipment room layout. Room layout shall show location and mounting requirements for filters, reactors, or other devices required. All additional equipment shall meet the seismic anchorage requirements as described in Paragraph F of this Section.
 - 4. Simulation report, analysis, and design shall be included in the Contractor's bid price.
 - 5. Additional filters, reactors, enclosures, conduit, wire, and all other components necessary for a fully functioning system complying with IEEE 519 for general systems shall be included in the Contractor's bid price.
- F. Seismic design certifications and anchorage descriptions as required by Section 01190.
- G. Submit certified factory test report before equipment is shipped.
- H. Manuals: Provide in conformance with Section 16010.

- I. Submit certification that VFD, motor, and driven load are compatible throughout the specified speed range.
- J. Submit list of manufacturer's recommended spare parts.
- K. Submit certified statement from the manufacturer accepting responsibility for providing a fully functioning installation as specified herein.
- L. Submit certified test reports of the VFD field tests.

1.04 COORDINATION

- A. Motor: Obtain and review the appropriate data for the driven motor and load over the required speed range, for a complete system analysis. Verify that equipment is mutually compatible and free of resonance over the complete operating range. Coordinate the assignment of any critical frequencies with the motor supplier per Sections 11002. Prepare the certificate required under Submittals paragraph in this Section. The certificate shall specifically state whether the VFD equipment is rated for variable torque or constant torque applications.
- B. Instrumentation and Controls: Review and coordinate requirements with the instrumentation and controls work of Division 17. Provide all necessary interfacing to produce a complete, fully operational system.

PART 2 - PRODUCTS

2.01 SYSTEM

- A. General: Provide integrated, all solid state variable frequency drives (VFD) complete with incoming line reactors. Provide all additional components necessary to meet IEEE 519 as described below. System shall comply with NEMA ICS 1, 3, 4, 3.1, 4, and 6.
- B. Manufacturers: Products of the following manufacturers are acceptable, subject to conformance with these Specifications.
 - 1. Mitsubishi Electric Automation, Inc. (MEAU), Type FR-F800VFD or approved substitute.
- C. Operation: Accomplish speed control by adjusting the output frequency according to the desired reference speed. Adjust ac voltage and frequency simultaneously to provide the constant volts/Hertz necessary to operate the motor at the desired speed. The VFD must use pulse width modulation (PWM) technology.
- D. Maintainability: VFD controller's parts shall be interchangeable and modular for all controllers.

- E. Torque Requirements: Duty rating shall be "Normal Duty" for a non-clog centrifugal pump motor.
- F. The dimensions of each cabinet shall be maximum 32-inches wide by 90-inches tall by 20-inches deep. Each cabinet shall contain one VFD with interior line and load reactors, and one VFD bypass.
- G. Each VFD with associated line and load reactors and with another VFD rated bypass shall be provided in a NEMA 1 or 12 rated cabinet. Cabinets shall be floor standing, and will include a main circuit breaker disconnect rated 600V three phase, and all other system components as required for the application.
- H. The VFDs shall use native communication protocols such as Modbus RTU, or approved substitute communication option cards.
- I. Minimum Continuous Current Ratings: Minimum 115% of the full nameplate current of driven motor at rated voltage, torque and speed or current rating specified, whichever is greater.

The VFD size shall be coordinated with the motor being driven. The VFD shall be capable of controlling either a conventional 3 phase induction motor or an IPM (Internal Permanent Magnet) motor. An auto-tuning system shall provide the ability to drive 3rd party IPM motors.

- J. VFDs shall meet all applicable Federal, Hawaii State, and City safety requirements.
- K. Any and all other standard items of equipment, components and accessories as listed in the manufacturer's specifications and/or brochures for a complete operating unit, whether specified herein or not, shall be included.
- L. The Contractor shall provide three (3) hard and one (1) digital copy of the Manufacturer's service and repair manual and Parts Manual.
- M. The equipment and its components shall include a warranty against factory defects for a period of 3 years, and this warranty shall cover both labor and parts cost. The Contractor shall furnish a copy of the warranty for each component with the delivery of each equipment.

2.02 QUALITY ASSURANCE/CERTIFICATIONS

- A. The manufacturer of the VFD shall be a certified ISO 9001 and ISO 14000 facility.

- B. The VFD, including its internal electronic thermal overload protection circuit, shall be UL and cUL Listed in accordance to UL 508C - Power Conversion Equipment.
- C. UL/cUL labels shall be attached on the outside of each VFD as verification.
- D. The VFD shall be designed in accordance with NEMA, IEC, EN, UL and CSA standards.
- E. The VFD manufacturer shall have an existing local service provider.
- F. The manufacturer of the VFD shall have the ability to design and manufacture insulated gate bipolar transistors (IGBT) to be incorporated into the construction of the VFD.
- G. The manufacturer of the VFD shall have the ability to evaluate any component failure at their own analysis lab. The services available shall include x-ray magnification of components, complete electrical testing, and the ability to analyze failures within the components.

2.03 HARMONICS

- A. All line side harmonic suppression devices used to eliminate or deal with harmonics in any way shall be integral with the VFD controller.
- B. Output filters, used to protect motors from high voltage reflections, may be installed external to the VFD.
- C. VFD controller's performance shall be in compliance with the latest version of IEEE 519.

2.04 INVERTERS

- A. Output voltage: Adjustable and controlled by the value of output frequency to maintain a constant ratio of volts per Hz throughout the operating range. The volts per Hz shall be internally field adjustable.
- B. Capable of varying the speed of any standard NEMA B or NEMA E design, squirrel cage, induction motor with a 1.15 service factor.
- C. A single unit, with no paralleling of smaller inverters.
- D. Suppresses output dV/dT high voltage spikes and shall be compatible with the motors specified in these specifications.
- E. 3% load and 3% line reactors.

2.05 GENERAL FEATURES

- A. Inverters output shall be conditioned to prevent high voltage ringing on motor leads. Output filters are acceptable.
- B. Microprocessor controlled pulse width modulation output voltage control strategy.
- C. Utilize pulse width modulation control techniques such that the maximum root mean square motor line current at rated voltage, torque and speed is less than 1.05 times that motor nameplate current.
- D. Power devices to have peak reverse voltage ratings of 2.5 times load side voltage.
- E. Insensitive to incoming power phase sequence.
- F. Incorporate a radio filter capable of meeting product standard EN61800-3 for Second (2nd) Environmental.
- G. Incorporate a forward/reverse pump start sub routine to assist with starting clogged pumps.
- H. Employ a conformal coating on the main control board.
- I. Incorporate a dedicated USB port for programming.
- J. Include three-wire cooling fans that warn user when cooling fans are obstructed.
- K. Include capacitors rated at no less than 105C for use in critical locations.

2.06 RATINGS

- A. Rated Input Power: 480V, +10 percent or –5 percent, three phase, 57 to 63 Hz incoming voltage imbalance of ± 3 percent.
- B. Rated Output Power: 0 to 460V, ± 1 percent, three-phase, 1 to 90 Hz.
- C. Frequency Drift: ± 0.5 percent.
- D. Voltage Regulation: ± 1 percent rated value no load to full load.
- E. Speed Regulation: 3 percent.

- F. Each VFD shall be designed to operate in the following Ambient Temperature range: Variable Torque and Constant Torque loads: –10C to +50C (14 to 122F).
- G. The maximum relative humidity shall be 90% at 50C (122F), non-condensing.
- H. VFD Efficiency: A minimum of 95 percent at 100-percent speed and torque at 40 degrees C ambient based upon measurement of input power versus output power with all specified components in system.
- I. Displacement Power Factor: The minimum displacement power factor for each VFD controller shall present to the AC system shall be 95 percent at all speeds. The unit shall be designed to inherently provide this minimum power factor.
- J. Speed Range: 40:1.
- K. Input Speed Signal: Provisions for a 4-20 mA DC from an external source. Input shall be isolated.
- L. Output Contacts: Four electrically isolated, programmable auxiliary status contacts, 5A at 120 VAC, one for "Run", one for "Fault", one for "Seal Water Solenoid Valve Control", and one spare.

2.07 ANALOG INPUT FREQUENCY CONTROL AND REGULATION

- A. Range: 4 mA DC at minimum equipment speed and 20 mA DC at maximum equipment speed.
- B. Accuracy: 1.0 percent of span.
- C. Deadband: 0.5 percent of span.
- D. Repeatability: 0.5 percent of span.
- E. Input signal impedance: 200 ohms minimum, with isolated two wire signal follower.
- F. Adjustable minimum and maximum output frequency limits.
- G. Independent timed linear acceleration and deceleration functions adjustable from 1 to 600 seconds.

2.08 MICROPROCESSOR DIGITAL CONTROL

- A. Drive operating parameters programmable.

- B. Sealed keypad with pushbuttons or sealed membrane type keypad with LED or LCD display, mounted on motor control center door.
- C. Operating parameters, fault, and diagnostic data maintained in nonvolatile memory with historic log of fault and diagnostic data for a minimum of the five most recent events, accessible via keypad and RS232/RS422 serial port.
- D. Provide data transfer capabilities with the existing SCADA network.
- E. Utilize English messages and engineering units.
- F. Menu driven.
- G. Password security.
- H. Provide control logic and adjustable time delay from 30 seconds to 5 minutes that on loss of network communication connection, when in AUTO mode, the VFD shall be de-energized.
- I. Computer Interface via RS232/RS422 Serial Communication Port:
 - 1. Provide configuration/setup software.
 - 2. Provide panel face mounted serial communication port.
 - 3. Adjust drive-operating parameter.
 - 4. Fault and diagnostic data accessible.
 - 5. Isolated from equipment ground so that no connection of a computer powered by the 120 VAC power can cause damage to the computer or the VFD serial communication ports.
- J. Display fault and diagnostic data.

2.09 BASIC DRIVE FEATURES AND FUNCTIONS

- A. Automatic Restart Feature:
 - 1. Field selectable.
 - 2. Faults: Overvoltage and Undervoltage
 - 3. Final fault, requiring manual reset, if restart is not successful after three attempts at 30-second intervals within 90 seconds.
 - 4. Provide drive with the ability to start into a motor that is spinning in the forward direction and assume normal operation upon auto restart of the drive.
- B. Upon restoration of AC power after a loss of utility or standby power, the VFD controller shall not attempt to restart automatically unless an external start signal is received. The drive shall not require a local manual reset after a power failure in order to restart, unless another alarm condition is active that requires operator intervention.

- C. 30 percent voltage dip ride through capability for one cycle.
- D. Controllers shall be compatible and tolerant of disturbances produced by other VFD controllers and shall not interfere with each other.

2.10 ADJUSTMENTS

- A. Maximum frequency: Adjustable 60 to 90 Hz.
- B. Minimum frequency: Adjustable 6 to 40 Hz.
- C. Speed: Frequency maximum and frequency minimum.
- D. Independent acceleration and deceleration rates: Field adjustable with minimum range of 3 to 300 seconds.
- E. Voltage parameters: Minimum and maximum voltage and volts/Hz.
- F. Current limit:
 - 1. Normal duty: 50 to 110 percent of drive limit for 1 minute.
 - 2. Heavy duty: 50 to 150 percent of drive limit for 1 minute.
- G. Inverse time overload: NEMA Class 20.X
- H. Speed shedding: Automatic upon low voltage.
- I. Speed profile: Starting ramp, stopping ramp, minimum speed, and maximum speed.

2.11 PROTECTIVE FEATURES AND FUNCTIONS

- A. Current limiting fuses, regulators, or other techniques for both internal and external fault protection.
- B. Overvoltage protection on the incoming AC line.
- C. Ground fault protection.
- D. Single-phase fault or three-phase short-circuit on VFD output terminals without damage to any power component.
- E. Overspeed (overfrequency).
- F. Class 20 motor overload protection meeting NFPA 70 requirements.
- G. Line or fuse loss.

- H. Power unit over-temperature.
- I. Circuit protection for the following conditions:
 - 1. VFD fault.
 - 2. Motor protection interlock.
- J. DC bus discharge circuit for protection of operator and service personnel with indicator lamp.
- K. Individual transistor overcurrent protection.
- L. Provides safe drive shutdown on following faults:
 - 1. Loss of input power.
 - 2. Sustained input undervoltage (-15 percent).
 - 3. Sustained gradual overload.
 - 4. Instantaneous severe overload.
 - 5. Power transistor over-temperature.
 - 6. Blown fuse.
 - 7. Logic power supply failure.
- M. Voltage transients: Provide solid state transient protection to meet or exceed ANSI C37.90.
- N. Overcurrent protection: The VFD system shall provide adjustable electronic current limit. Current shall be accurate to within 1.0 percent and shall smoothly limit motor speed at whatever value is necessary to limit motor current to that value.
- O. Short-Circuit Protection:
 - 1. The VFD shall be fully protected against load faults via electronic overload protection.
 - 2. Bolted, phase to phase, or phase to ground faults shall not damage the unit.
 - 3. Fault protection shall be based on a power source short circuit capacity of up to 42,000A rms symmetrical at the VFD power input terminals. Any impedance or other current limiting necessary to meet this requirement shall be provided as part of the VFD system, and any losses caused by current limiting devices shall be included in efficiency calculations for the VFD system.
- P. Line voltage: The VFD shall be protected against high and low line voltage on one or more phases.
- Q. Internal faults: The VFD shall incorporate an internal fault monitoring system to detect malfunctions. This system shall be designed to protect the VFD from transient and sustained faults and to limit damage that may be caused by these faults.

- R. Motor Over-Temperature:
1. Each VFD shall be capable of interfacing to motor temperature switches and shall shut down if the motor becomes overheated.
 2. Each VFD shall include a motor winding temperature relay. Provide all components necessary to sense a contact opening and disconnect the affected motor if the motor winding temperature exceeds maximum rated operating temperature.
 3. Configure one of the programmable inputs for motor winding high temperature shutdown.
 4. Include a manual reset provision to manually reset the shutdown after a motor over-temperature trip.
- S. Human Interface Module (HIM):
1. Provide an MCC door-mounted HIM with integral LCD display, operating keys and programming keys.
 2. The HIM shall have a “copy cat” feature which allows for the drive parameters to be saved to EEPROM in the HIM.
 3. The display shall show drive operating conditions, adjustments, and fault indications.
 4. The display shall be configured to display user configurable and scalable parameters.
 5. The HIM shall provide start and digital speed control in the manual operating mode. In the remote operation mode, automatic start/stop control and digital speed control.
 6. The keypad shall be a full numeric keypad and shall include programming keys and drive operating keys (Start, Stop, Direction, Jog and Speed Control) and status indication.
 7. The display shall be configured to show the speed reference and the output speed and the manual-automatic mode status.

2.12 SPECIAL FEATURES AND FUNCTIONS

- A. Control power transformer:
1. Secondary; 500VA minimum with additional capacity to power the motor space heaters where required.
 2. Two primary fuses and one secondary fuse with non-fused secondary leg grounded.
 3. Blown fuse indicators.
 4. Independent transformer utilized for internal VFD electronic controls.
- B. Manual/Auto control interface requirements:
1. Manual control when placed in “Hand” shall enable the HIM.
 2. Remote control via Modbus TCP interface. Modbus TCP interface control shall include remote start, stop, speed control, run status monitoring, fault status monitoring, speed monitoring via Cat-6 cables.

- C. Six (6) programmable 120 VAC inputs to be programmed for the inputs specified on the Drawings.
- D. Four (4) programmable outputs, form C, to be programmed for the outputs specified on the Drawings. Minimum ratings as follows:
 1. Max resistive – 240VAC/30VDC, 1200VA, 150W, 5A.
 2. Max inductive - 240VAC/30VDC, 840VA, 105W, 3.5A.

2.13 SPARE PARTS

- A. The VFD manufacturer shall provide one complete set of all plug-in controller components as spare parts for the VFDs supplied.
- B. Label spare parts and package in a sturdy container suitable for storage.
- C. As a minimum, furnish the following spare parts:
 1. One set of three of each type of power fuse.
 2. One set of 12 of each type of control fuse.
 3. One set of indicating lights.

2.14 OTHER TECHNICAL VFD REQUIREMENTS

- A. Pulse width modulated (PWM) drive design suitable for use with NEMA Design B squirrel-cage induction motors rated 460V, three-phase, 60 Hz with 1.15 service factor.
- B. Converters: Full wave, three-phase solid state rectifier bridge to convert incoming fixed voltage and frequency to a fixed DC voltage. All components for converters shall be integral to the VFD enclosure.
- C. Digital input frequency control: The motor frequency shall be ± 0.01 percent of the frequency set through the network interface.
- D. Provide functionality to allow programming that prevents operation of the VFD at a minimum of two critical speeds.
- E. VFD overload capacity:
 1. Normal duty: 110 percent of continuous current rating for 1 minute or 150 percent for 3 seconds.
 2. Heavy duty: 150 percent of continuous current rating for 1 minute or 200 percent for 3 seconds.
- F. Cooling: The manufacturer of the VFDs shall provide fan cooling and door grating as necessary to maintain operating temperature ranges for free-standing VFDs. Where fans are provided provide overcurrent protection and isolation on all fan circuits.

- G. Noise Data: Free field noise generated by the VFD shall not exceed 85 dBA at 3 feet from any point of the VFD cabinet under any normal operating condition.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Installation shall be in conformance with Section 16010.
- B. Provide 3-inch-high concrete housekeeping pad under each VFD; coordinate dimensions to ensure conformance with the NEC 6' 7" rule (NEC 404.8).
- C. Properly level and plumb VFDs so that doors will open and close freely.
- D. Clean and repair scratched or damaged surfaces to "new" condition.
- E. Coordinate the location of the isolation transformer, the size of the incoming line circuit breaker, and the size of isolation transformer secondary conductor to comply with NEC Article 240 and 450.
- F. Provide the services of a factory trained service technician to inspect and check out each system before energizing.
- G. Lace power conductors to resist short circuit forces. Follow manufacturer's instructions.

3.02 FIELD TESTING

- A. Provide the services of a factory trained service technician to make final adjustments to equipment and carry out a full operational test in the presence of the Officer-in-Charge.
- B. Replace any failed or damaged parts at no cost to City.
- C. Following installation and manufacturer's field test, perform a field test under utility operating conditions. Operate the drive from no load to full load and perform a spectrum analysis to verify that the waveform on the line side of the VFD is in compliance with IEEE 519 for general systems. Submit a complete certified test report for review by the Officer-in-Charge. If compliance has not been attained, provide additional equipment as specified herein and perform the test again.

3.03 TRAINING

- A. Service technician shall instruct operating personnel in the operation, maintenance and adjustment of the system and installation.

END OF SECTION

SECTION 16955

CONTROL DEVICES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Provisions: Applicable provisions of Section 16010 become a part of this Section as if repeated herein.
- B. Work Included: Furnish and install all control devices complete, including, as applicable, enclosures, engraved escutcheons or nameplates, gaskets, lenses, lamps and mounting provisions.
- C. Related Work Specified Elsewhere:
 - 1. Section 16920: Motor Control Centers
 - 2. Section 16924: Variable Frequency Drives (VFD) over 5 Horsepower
 - 3. Section 17510: Panels

1.02 REFERENCE STANDARDS

- A. National Electrical Manufacturers Association (NEMA) Publications:
 - 1. ICS1 General Standards for Industrial Controls and Systems
 - 2. ICS2 Standards for Industrial Control Devices, Controllers and Assemblies
 - 3. ICS6 Enclosures for Industrial Controls and Systems

1.03 SUBMITTALS

- A. Submit material or equipment data in accordance with General Conditions Section 5 and the submittal requirements of Section 16010.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All control devices shall conform to applicable provisions of NEMA Standards ICS1 and ICS2.

2.02 CONTROL AND TIMER RELAYS

- A. General: Relays shall be provided as necessary to perform switching functions required of control panels and other control circuits. Relays shall be of the following types (abbreviations in parentheses correspond to labels on the Drawings):
1. Size 0 Magnetic Contactors (MS): Provide Size 0 magnetic contactors for driving Size 4 and Size 5 ac operated motor starters. Provide Size 0 contactors of the same type and manufacture as the motor starter contactors.
 2. Relays (CR):
 - a. Provide machine tool relays for the following applications:
 - 1) All relays driving 120 Vac motor starters up to and including Size 3.
 - 2) All relays driving non-motor loads up to 6 amps (or 720 VA).
 - b. Provide machine tool type relays with convertible contacts rated 10 amperes continuous with NEMA Rating Designation A600 for ac applications and N600 for dc applications. Coils shall be designed for continuous duty and shall have the voltage rating indicated on the Drawings.
 - c. Relays shall be the magnetically held type unless designated otherwise on the Drawings. For each relay provide one spare Form C contact over and above the number indicated on the Drawings. In addition, for latching relays, provide coil clearing contacts as necessary.
 - d. Manufacturer: Square D, Class 8501, Type X; General Electric CR120B; or approved substitute.
 3. General Purpose Control (GR) or (AR) Relays (plug-in):
 - a. Provide plug-in style 2-, 3-, or 4-pole enclosed relays with integral neon or LED indicators for the following applications:
 - 1) Relay logic (relays driving other relays, including machine tool relays) operating at voltages up to 120 Vac.
 - 2) Control power switching.
 - 3) All relays driving non-motor loads up to 2 amps (240 VA) at 120 Vac.
 - b. Provide relay sockets rated for 10 amp, 240 Vac with screw-type barriered terminals.
 - c. Manufacturer: Square D, Class 8501, Type R; Allen-Bradley Bulletin 700; or approved substitute.
 4. Analog or Digital Signal Switching (SR) Relays: Provide plug-in style indicating type relays with gold plated silver contacts for switching low level currents (less than 100 mA). Provide relay sockets screw-type barriered terminals.
 5. Latching Relays (LR): Latching relay shall be 600 volt machine tool industrial relays, magnetically held, two-coil type. Relay shall have convertible contacts rated 10 amperes with NEMA rating design A600.

- Latching relay shall be Square D Class 8501; General Electric CR170BL; or approved substitute.
6. Timing Relays (TR) and (TD): Time Delay Relays (TD): Relay shall be solid-state with multi-range programmable settings. The relays shall include a calibrated front dial and LED indicator and shall be complete with socket. Relays shall be "on delay" or "off delay" type as indicated on the Drawings. Provide an additional form C contact over and above the number indicated on the Drawings. Relay contacts shall be rated 10 amps, 120 Vac. Relays shall be ATC Type 328; Idec Type RTEL; or approved substitute.
 7. General Requirements:
 - a. Provide relays rated for 1 million operations at 10 amp, 120 Vac, at power factor of 0.2.
 - b. Where timing relays are interfaced to motor starters or adjustable speed motor controllers, provide auxiliary machine-tool relays or Size 0 magnetic contactors. Refer to previous specifications for machine-tool relays and Size 0 magnetic contactors.
 - c. Where timing relays or control relays require additional contacts, provide auxiliary control relays, properly sized for the application as described previously in this Section.

2.03 ZERO-CROSSING RELAYS

- A. General:
 1. Provide solid state output zero-crossing relays where indicated on the elementary diagrams. Provide zero-crossing relays which actuate for any input control voltage between 10 and 120 Vac. Provide inverse-parallel dual SCR output rated for 10 amps at 120 Vac, suitable for low power factor inductive loads. Provide integral snubber circuit for SCR output to limit dv/dt to protect the triac from damage by highly inductive loads.
 2. Provide 2,500 Vac isolation from input circuit to output circuit.
- B. Installation: Mount zero-crossing relays on the rear panel of the control panel with panhead machine screws, using thermally-conductive heat sink compound. Remove excess compound to prevent accumulation of dirt and debris.
- C. Manufacturer: Provide International Rectifier "Crydom" Model A1210; equivalent model as manufactured by Teledyne; or approved substitute zero-crossing relays.

2.04 ALTERNATOR RELAYS (ALT)

- A. Alternator relay shall alternate the state of its contacts in response to impulses applied to its coil. Contacts shall be rated 5 amperes minimum at 120 Vac, 60 Hz. Coil shall be rated 120 Vac, 60 Hz. Provide stud terminals

for all wiring. Alternator shall be Autocon 7101AA; Struthers Dunn B11AXA; or approved substitute.

2.05 INTRINSICALLY SAFE RELAYS (ISR)

- A. Unit shall be fixed sensitivity type and either UL or FM approved for use with a remote pilot device (dry contact) located in Class 1, Division 1, Groups C and D atmospheres. Supply power shall be 120 Vac, 60 Hz. Provide load contacts as shown on the Drawings, except provide a minimum of one single-pole double-throw set. Contact ratings shall be 10 amps or better at 120 Vac. Unit shall be BW Series 53; Warrick Series 7; or approved substitute.

2.06 INTERVAL TIMERS (IT)

- A. Interval or SS (single shot) timers shall transfer their timed contacts immediately when energized by a control power pulse of 50 milliseconds minimum duration. The contacts shall remain transferred for the preset delay and then reset independently of the control input. A source of continuous operating power is required, if the control pulse is of shorter duration than the delay; interruption of this power shall reset the contacts at any time. Interruption of control power for 50 milliseconds maximum shall be required to initiate a new time cycle. Timer shall be ATC Series 305D; Eagle Signal; or approved substitute.

2.07 REPEAT CYCLE TIMERS (RCT)

- A. Repeat cycle timers shall incorporate two time functions. The first is a fixed time cycle. The second is an adjustable time which is the dial setting percentage of the fixed cycle time. The timer contacts shall transfer from the normal state when control power is applied and reset after the preset time. They shall transfer again after the fixed cycle time has elapsed. This cycle shall repeat as long as control power is applied. Timers shall be ATC Series 306D; Eagle Signal; or approved substitute.

2.08 RESET TIMER (RT)

- A. General: Provide digital electronic reset timer with range of 0 to 99.9 hours. Timer shall reset from zero to the time set on the pointer by means of an external momentary dry contact closure.
- B. Specifications: Provide reset timer with the following specifications:
 1. Models: Choice of on delay or off delay operation.
 2. Ranges: 16 standard ranges, from 6 seconds to 60 hours at 60 Hz.
 3. Repeat Accuracy:
 - a. ac Models: $\pm 0.2\%$ of full scale.

- b. dc Models: $\pm 1.75\%$ of full scale at constant ambient temperature and $\pm 20\%$ voltage variation (48, 125 and 250 volt models); $\pm 3.5\%$ of full scale at constant voltage and 32 to 120°F ambient temperature variations (all models).
 - 4. Reset Time: 0.1 second, full scale.
 - 5. Minimum Setting: 1/60th of range.
 - 6. Dial Divisions:
 - a. 6 sec, 60 sec, 120 sec, 240 sec, 6 min, 60 min, 120 min, 240 min, 6 hr, and 60 hr with 120 Dial Divisions.
 - b. 15 sec, 30 sec, 15 min, 30 min, 15 hr, and 30 hr with 150 Dial Divisions.
 - 7. Life Expectancy:
 - a. Mechanical: Over 5,000,000 operations (average.)
 - b. Contacts: 3,000,000 operations under resistive or inductive load of 1 amp.
 - 8. Timing Motor: Synchronous, permanently lubricated.
 - 9. Timing Modes: Single cycle interval or delay.
 - 10. Load Switches:
 - a. Instantaneous: Two, each SPDT; self-cleaning, heavy-duty silver contacts.
 - b. Delayed: Two, each SPDT; precision type, silver contacts.
 - c. Contact Rating (non-inductive):
 - 1) 10 amps: 120 Vac.
 - 2) 5 amps: 240 Vac.
 - 3) 1/4 amp: 115 Vac.
 - 11. Pilot Light: Wired in parallel with motor, standard with all ac models except explosion-proof.
 - 12. Terminals: Screw terminals accessible at rear, integral wiring diagram on timer housing.
 - 13. Housing: Plug-in design; completed gasketed, dust-tight when surface or panel-mounted.
 - 14. Power Requirements:
 - a. ac Models: 120 or 240 V, 50/60 Hz. (all ranges).
 - b. dc Models: 48, 125 or 250 V with zener regulations; 28 V without zener regulation.
 - c. ac Models:
 - 1) Running Current: 0.128 A (115 Vac).
 - 2) Inrush Current: 0.628 A (115 Vac).
 - 15. Temperature Rating: 32° to 120°F (0 to 50°C).
- C. Manufacturer: Provide reset timer as manufactured by ATC; Eagle Signal; or approved substitute.

2.09 ELAPSED TIME METERS (ETM)

- A. Elapsed time meters shall be of the synchronous motor-driven type having a minimum of six (6) decimal digits where the least significant digit shall

represent tenths (1/10ths) of hours. Unless specified otherwise, they shall not be equipped with a reset button. They shall be for panel mounting with a square bezel approximately 2-1/2 inches on a side. Meter voltage shall be not more than 120 Vac for meters mounted in instrumentation panels.

Elapsed time meters shall be ATC 5702; Yokogawa/General Electric Series 200; Type 240; or approved substitute.

2.10 CONTROL PANEL ACCESSORIES

- A. Relays, timers, and other internally mounted equipment shall be of the types specified in other sections of these Specifications.
- B. Panel face mounted equipment shall be of the types specified in other sections of these Specifications.
- C. Standards: All control devices shall conform to applicable provisions of NEMA Standards ICS 1 and ICS 2.
- D. Pushbuttons, Selector Switches, and Pilot Lights:
 - 1. Shall be heavy-duty oiltight units; each unit shall have an engraved escutcheon plate unless nameplates are indicated on the Drawings or are necessary because of length of identification. Pushbuttons and selector switches shall have contacts rated 10 amperes continuous, Rating Designation A600 in conformance with NEMA ICS 2.
 - 2. Pushbuttons used as emergency stop devices shall have a padlockable means for maintaining an open circuit. Indicating lights shall be push-to-test transformer type with lenses of the colors shown on the Drawings.
- E. Multiposition control switches shall have rotary action, round knurled handle and the number of positions and stages shown on the Drawings. They shall be suitable for panel mounting. Each position shall have a positive detent. Contacts shall have a continuous current rating of 10 amperes at 300 Vac. Switches shall have integral indicator.
- F. For 4-20 mAdc and 1 to 5 Vdc signal selector switches, provide oiltight selector switches with electronic duty gold contact blocks. Provide sliding contacts for reliable operation without benefit of thermal cleaning action.
- G. Manufacturer: Provide Microswitch heavy-duty oiltight manual controls, Type PT with electronic duty gold contact blocks; Allen-Bradley Bulletin 800T oiltight selector switch with stackable "Logic-Reed" contact blocks; or approved substitute.
- H. Colors and Descriptions:
 - 1. Indicating Lamps: Unless otherwise noted on the Drawings, the following color code and inscriptions shall be followed for the lenses of all indicating lights.

Indicating Lamp Inscription	Color
ON/START	Red
OFF/STOP	Green
CLOSED	Green
LOW	Amber
FAIL	Red
HIGH	Amber
OPEN	Red
POWER ON	White
RESET	Red
AUTO	Blue

- 2. Lettering shall be black on white and amber lenses. Lettering shall be white on red and green lenses.
- 3. Pushbuttons: Follow color coding for indicating lamp above.
- 4. All unused or noninscribed buttons shall be black. Lettering shall be black on white and yellow buttons. Lettering shall be white on black, red and green buttons.
- I. Panel Lights and Receptacles: Panels shall be internally lighted by LED lamps, provided with guards and a toggle switch located convenient to each access door. One duplex GFI type receptacle shall be provided in each panel section. The lights and receptacles shall be wired to outgoing terminal blocks for 120 volt, 60 Hertz, single phase supply.
- J. Nameplates: Unless specified otherwise in the Drawings, nameplates shall be black lacquered with minimum 3/16-inch-high white letters for major area titles, 5/32 inch for component titles, and 1/8 inch for subtitles, and shall be fastened with a permanent but dissolvable adhesive or by screws.

2.11 PROBE RELAYS (PR)

- A. Probe relays shall be solid state liquid level control relays suitable for use with water. The relays shall use an 8 Vac secondary circuit to sense the level of the water by means of electrodes. The relays shall have adjustable potentiometers for setting the sensitivity. Contacts shall be rated 230 volts, 10 amperes, 1/2 horsepower. The relays shall be Warrick Series 2; B&W Series 52; or approved substitute.

2.12 PROBES AND HOLDER

- A. Probes shall be 1/4-inch stainless steel rods, PVC insulated. Probe holder shall be case pressure tight, of sufficient size to accommodate all of the probes, threaded to match the probe well, and complete with pressure tight

probe plugs. Probes and holder shall be as manufactured by B/W Controller Corporation; Warrick; or approved substitute.

2.13 CONTROL STATIONS

- A. Provide control stations complying with NEMA ICS 6 for manual control functions as follows and as shown on the Drawings: start-stop pushbutton, hand-off-auto, forward-reverse-jog-stop, etc. Control stations shall include selector switches, pushbuttons, and indicators as specified in this Section.
- B. Enclosures shall be as follows:
 1. NEMA Type 4X
 2. Hazardous Locations (Gases): NEMA Type 7
- C. Nameplates: Provide an engraved plastic nameplate for each control station and escutcheons or nameplates for devices mounted thereon.
- D. Provide pushbuttons, selector switches, indicators, etc., as shown on the Drawings and as required. Provide control devices with NEMA ratings matching that of the control station.
- E. Manufacturer: Provide Allen-Bradley; Eaton; Crouse-Hinds; or approved substitute.

2.14 WATT AND VAR TRANSDUCERS

- A. The transducers shall provide 4-20 mAdc output signals proportional to ac power input in watts or volt-ampere reactive (VAR). The units shall be capable of driving into a load of 750 ohms. The calibrated power range shall be as shown on the Drawings.
- B. The units shall use all electronic design. Ambient temperature change influence shall be less than 0.5% over a range of -5° to 165°F. The units shall not drift more than ±0.25% per year. Accuracy shall be ±0.2% of full scale. Response time shall be less than 400 mS. The units shall be capable of operating with a power factor of unity to lead or lag zero.
- C. Units shall be capable of meeting surge withstand criteria ANSI C37.90.1-1989 (IEEE SWC). Units shall be self-powered from the input circuit unless noted otherwise.
- D. The number of phases, voltage level, current level, and number of wires shall be as required. The unit shall be enclosed in a NEMA 12 steel enclosure with mounting plate.
- E. Unit shall be Rochester Instrument Systems Series PCE for watt and Series VCE for VAR transmitters; Crompton Industries; or approved substitute.

PART 3 - EXECUTION

3.01 GENERAL

- A. Identify all control devices with engraved plastic nameplates or escutcheons, as applicable. Install control devices as recommended by the manufacturer.

3.02 PROBES AND HOLDER

- A. Adjust potentiometer to suit conductivity of water.

END OF SECTION

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SECTION 16961

POWER SYSTEM STUDIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Provisions: Applicable provisions of Section 16010 become a part of this Section as if repeated herein.

1.02 SCOPE OF WORK

- A. Obtain the services of an independent firm to provide complete Short-Circuit and Protective Device Coordination studies, and Arc Flash Risk Assessment for the electrical system as defined below. The firm performing the work shall have been regularly engaged in short-circuit and protective device coordination services for a period of at least 10 years.
- B. The firm performing the work shall be responsible for the collection of all data required to perform the studies, including the electrical utility company's short-circuit current contribution.
- C. For the purpose of this specification Section, the "Electrical System" shall be defined as the entire power distribution system, including the utility company's main service disconnect down through the main circuit breaker on each 240/120VAC and 208/120 VAC panelboard of all distributed branch circuits. Some equipment not modified as part of this contract is required to be included in the studies defined in this Section. Items within the "Electrical System" are comprised of:
 1. All utility transformers
 2. All medium voltage equipment
 3. All medium voltage to low voltage transformers
 4. All 480 VAC generators, transfer switches, switchboards, panelboards, distribution, power conditioning, motor control, and motors
 5. All 480-208 VAC and 480-240 VAC transformers feeding panelboards
 6. All 208 VAC and 240 VAC panelboards.
- D. The Short-Circuit Study shall provide for the calculation of fault currents at each piece of gear in the Electrical System for the entire Site. Fault currents shall be calculated for scenarios of utility and standby power, as outlined in this Section.
- E. The Protective Device Coordination Study shall include trip characteristics for all protective devices in the Site Electrical System, from the utility company's main service disconnect through the main circuit breaker on each 208/120 VAC panelboard of all distributed branch circuits. Trip characteristics shall be analyzed for scenarios of utility and standby power, as outlined in this Section.

- F. The Arc Flash Risk Assessment shall provide for arc flash incident energy calculations at all panels as required by IEEE 1584 (2018 Edition) and NFPA 70E.
- G. Reports:
 - 1. Reports for the Short-Circuit Study, Protective Device Coordination Study, and Arc Flash Risk Assessment shall be stamped and signed by a Hawaii Registered Electrical Engineer.
 - 2. Report calculations shall be generated by a software analysis application with proven accuracy and reliability at performing 3-phase fault calculations.

1.03 REFERENCE STANDARDS

- A. Institute of Electrical and Electronics Engineers, Inc. (IEEE)
- B. American National Standards Institute (ANSI)
- C. The National Fire Protection Association (NFPA)
- D. InterNational Electrical Testing Association (NETA) Standard for Acceptance Testing Specifications (ATS)
- E. NFPA 70E, Standard for Electrical Safety in the Workplace
- F. IEEE 1584 (2018 Edition), Guide for Performing Arc-Flash Hazard Calculations
- G. Occupational Safety and Health Administration (OSHA) (29 CFR PART 1910), Occupational Safety and Health Standards for General Industry

1.04 SUBMITTALS

- A. Submit data in accordance with the Product Review category of the General Conditions and the submittal requirements of Section 16010.
- B. Submit credentials of firm performing the studies to demonstrate sufficient experience with performing this type of work, as specified herein.
- C. Preliminary: Preliminary Short-Circuit Study, Protective Device Coordination Study, and Arc Flash Risk Assessment shall be submitted to the Engineer for review prior to release of equipment drawings for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the Engineer may be obtained for preliminary submittal of sufficient study data to ensure that the selection of device and characteristics will be satisfactory.
- D. Results of the Short-Circuit Study, Protective Device Coordination Study, and Arc Flash Risk Assessment shall be summarized in a final report. Submit hardbound copies of the complete final report and one digital copy in PDF on a CD. Electronic delivery shall contain full searchable text, and include any computer models developed for the studies at no additional cost.

- E. Sample arc flash warning labels for each piece of equipment. Submit copies of labels at full size, with all required information as calculated by the Arc Flash Risk Assessment.

1.05 DATA COLLECTION

- A. The firm performing the Short-Circuit Study, Protective Device Coordination Study, and Arc Flash Risk Assessment shall furnish the Contractor with a listing of required data. The Contractor shall collect and furnish all required data. The Contractor shall expedite collection of the data to eliminate unnecessary delays and assure completion of the studies as required for final acceptance of the equipment shop drawings and/or prior to the release of the equipment for manufacturing.

1.06 MANUFACTURERS' SERVICES

- A. The switchgear manufacturer shall furnish the services of a qualified field engineer and necessary tools and equipment in order to test, calibrate, and adjust the protective relays and circuit breaker trip devices as recommended in the Protective Device Coordination study.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS

- A. The Short-Circuit Study and Protective Device Coordination Study shall be performed as outlined in InterNational Electrical Testing Association (NETA) Standard for Acceptance Testing Specifications, Section 6 with exceptions as included in this Section.
- B. In order to select relays and fuse characteristics as required for optimum coordination, the coordination study shall be performed as soon as the vendors for the new electrical equipment are identified. Relays and fuse selection by the power distribution equipment suppliers shall be based on the results of the favorably reviewed study.
- C. The studies shall be submitted to the Engineer for acceptance before final acceptance of power distribution equipment submittals and before any settings are made on equipment.
- D. The final report for the Short-Circuit Study, Protective Device Coordination Study, and Arc Flash Risk Assessment shall be bound in a standard 8 1/2-inch by 11 inch sized report. The selection of all protective relay types, current transformers, and fuse types and ratings shall be the responsibility of the manufacturer and shall be based on the preliminary draft of the coordination study, which shall be submitted with the equipment shop drawings (or earlier).

The studies shall be accepted by the Engineer before any equipment is shipped. See Paragraph 1.04 for submittal requirements.

- E. The report shall include a single line diagram depicting the entire Electrical System included in the analysis. At a minimum, the single line diagram shall be on an 11-inch by 17-inch sheet, and include the following information:
 - 1. Equipment/bus tags which match the contract documents
 - 2. Equipment/bus ampacity ratings
 - 3. Motor horsepower
 - 4. Protective device frame rating, trip setting, and curve options, as applicable
 - 5. Transformer primary/secondary voltages, kVA rating, and impedance
 - 6. Conductor materials, insulation types, and lengths
- F. The studies shall be run on each of the following scenarios:
 - 1. Utility power
 - 2. Generator power

3.02 SHORT-CIRCUIT STUDY

- A. Provide a complete Short-Circuit Study. The study shall include, but shall not be limited to, the following, as applicable:
 - 1. Full compliance with applicable ANSI and IEEE Standards.
 - 2. Performed on nationally recognized computer software, such as ETAP or SKM Power Tools.
 - 3. Overall system impedance diagram. The diagram shall include the power company's impedance and X/R ratios and circuit element impedances (e.g., transformers, generators, motors, VFDs, feeders, distribution buses as applicable).
 - 4. Available three phase and ground fault asymmetrical and symmetrical short-circuit fault currents at each piece of electrical equipment, bus, transformer, etc.
 - 5. The momentary and interrupting rating of all elements of the distribution system shall be listed. The maximum available short-circuit fault current available at each element shall be calculated.
 - 6. Executive summary describing the distribution system, the procedures used to develop the study, utility related information furnished by the utility company, including the name and telephone number of the individual supplying the information, identification of all assumptions made in the preparation of the study, identification of any problem areas, and a definitive statement concerning the adequacy of the distribution system to interrupt and withstand the maximum possible short-circuit fault current.
 - 7. Computer printouts for the three phase, single phase and ground fault studies. Printouts shall indicate the short-circuit fault current available at each major equipment and distribution bus within the medium and low voltage distribution systems.

3.03 PROTECTIVE DEVICE COORDINATION STUDY

- A. Provide a complete Protective Device Coordination Study. The Protective Device Coordination Study shall include, but shall not be limited to:
 1. Utility protective devices.
 2. Service entrance and distribution switchgear.
 3. Medium and low voltage power system transformers.
 4. Low voltage switchgear, switchboards, power distribution panels and motor control centers.
 5. Power factor correction and harmonic mitigation equipment.
 6. Motor starters and variable frequency drives.
 7. Standby generators.
 8. A tabulation of all the settings for every over current protective device, timer, power system relays (e.g., ANSI 50, 51), circuit breaker, recommended fuse and current transformer ratings, etc.
 9. Transformer excitation current.
 10. Motor and cable damage curves in accordance with the manufacturer's recommendations.
 11. Select relay types (e.g., inverse, very inverse, extremely inverse, overcurrent with or without voltage restraint, timers), current transformer ratings and types, fuse, residually or zero sequence connected ground faults protection, etc. that will allow the system to be protected within the equipment fault ratings and provide the maximum possible coordination between the protective devices.
 12. Provide recommended settings for protective devices, such as relays and circuit breakers, to achieve the best selectivity to minimize system disturbances during fault clearing.
 13. Provide a complete set of time-current coordination curves on log-log paper for every protective relay, circuit breaker, fuse, timer, etc. serving or located in the electrical equipment furnished for the project, including the utility protective devices. Provide a separate time-current curve for each unique feeder system, without displaying parallel devices powered from a common bus. The time-current curves shall display the coordination from the lowest device in the distribution system up through the utility's protective device. Clearly identify each device curve displayed on the graph, by color coding and text callouts. Include specific settings used for the curve (as applicable) in the text callout. A single line diagram depicting the portion of the distribution system under study shall appear with each curve. The minimum size log paper to be submitted shall be 11-inch by 17-inch.
 14. Time current curves shall include transformer ANSI damage and inrush curves, cable damage curves, circuit breaker and fuse ratings and settings, protective relay settings, and any other information required by ANSI and good design practices. As a minimum, provide curves for:
 - a. Each medium voltage and low voltage feeder down to 480-volt motor control centers and panelboards.

- b. Each main, tie and feeder circuit breakers located in medium voltage and low voltage switchgear, motor control centers and panelboard. Include the largest feeder circuit breaker in each motor control center and panelboard.
 - c. Each ground fault protective device provided for the medium voltage and low voltage power distribution systems.
- B. The report shall include a reference to any part of the Electrical System where selectivity cannot be achieved, and a brief explanation of the cause. Provide recommendations where applicable for alternate methods that would improve selectivity.

3.04 ARC FLASH RISK ASSESSMENT

- A. Provide a detailed Arc Flash Risk Assessment. The analysis shall include, but shall not be limited to:
 1. Determine potential arc flash incident energies, arc flash boundaries, shock hazard boundaries and proper personal protection equipment (PPE) for all energized electrical equipment.
 2. The study shall determine worst-case scenarios for the arc flash energy level calculations, and any suggested changes to the protection scheme or equipment selection that will result in improved system reliability and safety.
 3. The study shall indicate the worst-case values for each of the scenarios listed in Paragraph 3.01F. Provide values in tabular format including at a minimum, location of fault, incident energy, arc flash boundary, working distance, acting protective device, protective device activation time, and arcing fault current.
 4. Provide executive summary, including introduction, methodology, information sources, key assumptions, NFPA 70E considerations and calculations.
 5. Develop and install arc flash warning labels based on arc flash study results.

3.05 FIELD ADJUSTMENT

- A. All field adjustment and modifications shall be performed in the presence of the Owner, before energizing equipment.
- B. Adjust relay and protective device settings according to the recommended settings table provided by the coordination study. Field adjustments shall be completed by the equipment manufacturer.
- C. Make minor modifications to equipment as required to accomplish conformance with Short-Circuit and Protective Device Coordination studies.

3.06 MODIFICATIONS

- A. Notify the Owner in writing of any required major equipment modifications. Major modifications to the equipment shall not be allowed unless otherwise approved in writing by the Engineer and the Owner.

3.07 ARC FLASH WARNING LABELS

- A. The vendor shall provide a 4 inch by 4 inch thermal transfer type label of high adhesion polyester for each work location analyzed. Labels shall be machine printed, with no field markings.
- B. The label shall have an orange header, compliant with ANSI Z535, with the wording, "WARNING, SHOCK & ARC FLASH HAZARD", and shall include the following information:
 1. Location designation (equipment identification tag)
 2. Nominal voltage
 3. Arc flash boundary
 4. Incident energy at working distance (in calories/centimeter-squared)
 5. Working distance
 6. Shock boundaries
 - a. Limited approach distance
 - b. Restricted approach distance
 7. Required personal protective equipment,
 8. Engineering report number, revision number and issue date.
 9. Where voltage exceeds 600 VAC or incident energy is greater than 40 cal/cm², label header shall be changed to "DANGER, SHOCK & ARC FLASH HAZARD."
- C. Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.
 1. For each 600, 480 and applicable 240 and 208 VAC panelboards and disconnects, one arc flash label shall be provided.
 2. For each industrial control panel, provide one arc flash label.
 3. For each transformer, provide one arc flash label at both the front and rear access points, as applicable.
 4. For each low voltage motor control center, at least one arc flash label shall be provided. Motor control centers larger than five sections shall bear one arc flash label for each five sections. Back-to-back or turned corner configurations shall be treated as two motor control centers for the purpose of labeling.
 5. For each 96-inches of low voltage switchboard, one arc flash label shall be provided.
 6. For each standalone VFD or motor starter, one arc flash label shall be provided.
 7. For each switchgear, provide one arc flash label for each the front and rear of the incoming compartment and one arc flash label on each compartment that houses a draw-out device.

8. For each medium voltage motor control center, provide one arc flash label each for the front and rear of the incoming compartment, one label for each individual starter or switch operating handle, and one label each for any draw-out power drawers.
 9. Where equipment includes a "maintenance mode" bypass setting on a protective device as a temporary arc-flash reduction measure, provide one arc flash label at the applicable protective device which indicates the calculated values when maintenance mode is enabled. This label shall be clearly marked to indicate what it represents.
- D. The Contractor shall affix the labels in accordance with the following:
1. Labels shall be in a clearly visible location on the front panel of the equipment near the incoming service or main protective device. Labels on equipment with bottom-entry incoming service shall be placed a minimum of 60-inches from the bottom of the equipment.
 2. Labels affixed to outdoor equipment which includes an outer door and inner deadfront panel shall be placed on the deadfront panel to avoid fading due to exposure to the elements.
 3. For labels affixed to removable compartment doors or covers, the removable cover shall be clearly marked to identify the specific compartment for which it is intended to be used.

3.08 ARC FLASH TRAINING

- A. The equipment manufacturer shall provide arc flash training to the Owner's staff. At a minimum, the training shall include potential arc flash hazards associated with working on energized equipment and maintenance procedures in accordance with the requirements of NFPA 70E, Standard For Electrical Safety Requirements For Employee Workplaces. The training shall be recorded in a video format and provided on a DVD or solid-state media to the Owner.

END OF SECTION

SECTION 17010

INSTRUMENTATION AND CONTROLS, GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. WORK INCLUDED:

1. Provide all tools, equipment, materials, and supplies and be responsible for all labor required to complete the installation, startup and operational testing of a complete and operable Instrumentation and Control (I&C) System as indicated on the Drawings and as specified herein.
2. Provide all the necessary equipment components and interconnections along with the services of manufacturers' engineering representatives necessary to ensure that the Owner receives a completely integrated and operational I&C system as herein specified.
3. Provide all terminations for wiring at field mounted instruments, equipment enclosures, alarm and status contacts.
4. Provide all Instrumentation and Control wire required for a fully functioning Instrumentation and Controls System as shown on the Drawings except for wire specifically specified in Division 16. See Section 16010.

B. WORK SPECIFIED IN OTHER DIVISIONS:

1. Process piping, installation of inline instrumentation and other mechanical work and equipment as specified in Divisions 11, 12, 13, 14, or 15.
2. Instruments and controls which are not directly used for process control, i.e., those provided as part of a package system, as specified in Divisions 11, 12, 13, 14, 15, or 16.
3. Division 16 work, including all instrumentation and controls conduit, and only that wire specified in Division 16. Refer to Division 16 Specifications for specific requirements for wire, conduit, grounding, and other electrical equipment.
4. Final control elements as specified in Section 15050.
5. General mechanical requirements as specified in Section 11001.

1.02 REFERENCE STANDARDS

A. AMERICAN NATIONAL STANDARD INSTITUTE (ANSI) PUBLICATIONS:

1. Y14.15a Drafting Practice
2. C62.1 Surge Arrestors

B. INSTRUMENTATION SOCIETY OF AMERICA (ISA) PUBLICATIONS:

1. S5.4 Instrument Loop Diagrams
2. S20 Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves

1.03 I&C SUBCONTRACTOR QUALIFICATIONS

- A. An I&C Subcontractor shall be an electrical contractor who has demonstrated experience in purchasing, calibrating, fabricating, installing and testing the Instrumentation and Control (I&C) products listed in this Specification Section. Normally, the I&C Subcontractor is a systems house regularly engaged in the business of panel fabrication, control component procurement, programmable logic controller and personal computer (PC) application in the process control industry.
- B. The I&C Subcontractor has been regularly engaged for a period greater than five years in performing all aspects of the type of work specified in this Section and shown on the Drawings.

1.04 I&C SUBCONTRACTOR SYSTEM RESPONSIBILITIES

- A. General: The I&C equipment as specified in this Division shall be considered an integrated system. Entire system installation including calibration, verification, startup, operation testing, and training shall be performed by qualified personnel, possessing all the necessary skills and equipment, and who have had experience performing similar installations. Instrumentation and control systems drawings are diagrammatic only; it is the responsibility of the Contractor to obtain technical data, determine performance requirements, develop instrumentation detail installation designs, and coordinate the selection of specified equipment with Contractor supplied equipment to meet the design conditions stated.

B. SYSTEM RESPONSIBILITIES:

1. Instrumentation and control system drawings are diagrammatic only. Ensure that all components of the instrumentation system, including primary measuring, indicating, transmitting, receiving, recording, totalizing, controlling, and alarming devices and all appurtenances are completely compatible and shall function as outlined and shall furnish and install such additional equipment, accessories, etc., as are necessary to meet these objectives at no cost to the Owner.
2. Compatibility: See that all components of the instrumentation system, including equipment specified under other Divisions, are completely compatible and function properly as a system. Provide such additional

- equipment, accessories, etc., as are necessary to meet these objectives at no cost to the Owner.
3. Coordination: For control components, devices, and systems specified in Divisions 11, 13, 14, 15, 16 and 17, or shown on the Drawings.
 - a. Provide technical advice to mechanical and electrical subcontractors as necessary regarding their installation of instruments.
 - b. Verify the correctness of installation of all instruments.
 - c. Verify that the proper type, size, and number of control wires with their conduits are provided.
 - d. Verify that the proper type, size, and number of pneumatic tubes with their conduits are provided.
 - e. Verify that proper electric power circuits provided for all components and systems.
 - f. Resolve all manufacturers' installation discrepancies between requirements and the detail requirements of the Drawings and Specifications.
 - g. Supervise final signal connections, both electric and pneumatic, to all process instrumentation and control equipment.
 - h. Adjust, startup, and test all process instrumentation and control equipment.
 - i. Provide specified documentation and training.
 4. Performance: While the Drawings provide sufficient information to establish the form and function of the systems and their relationships, the responsibility for system integration and performance rests solely with the Contractor. The Engineer provides technical instruction and guidance where needed.
 5. Site and Instrument Inspection: Inspect site for conformance to Drawings, paying special attention to space allocation and dimensions shown or required on Drawings. Inspect completed work and verify that it is ready for installation of instruments and equipment. Inspect each instrument and piece of equipment for damage, defects, completeness, and correct operation before installing.

1.05 SUBMITTALS

- A. Refer to Division 1 for required method of preparation and transmittal and conform to requirements herein.
- B. Shop Drawings: Submit shop drawings (diagrams) for review in complete bound sets indexed by Specification number, with exterior tabs marked by subject. Submit manufacturer's catalog cuts for each item for which shop drawings are not required. Manufacturer's catalog cuts, specifications or data sheets shall be clearly marked to delineate the options or styles to be furnished. Show dimensions, physical configurations, methods of connecting instruments together, mounting details, and wiring schematics. Drawings

shall be complete with device tag numbers, wire numbers and terminal board numbers. Submit fabrication details, nameplate legends, and control panel internal wiring and piping schematic drawings. Submit panel graphic drawings where applicable. Include material lists and/or bills of material.

C. SPECIFICATION FORMS:

1. Submit completed Specification Forms per ISA S20, including those instrumentation and control components directly related to process control, but specified in other Divisions of these Specifications.
2. Include on each form the assigned tag numbers, manufacturer's part numbers, and device data. More than one tag numbered item may be included on a sheet.

D. As-Built Drawings: Submit a revised set of shop drawings that incorporates all change orders and modifications made during performance of the work. In addition to updated loop diagrams, interconnect diagrams and elementary diagrams, submit equipment and device wiring diagrams (see Sketch 17010-4) and other drawings as necessary to depict the "as-built" condition of equipment. Include all installed field and panel conduit and piping/tubing runs and routing, tray systems, supports, mounting details, interconnection diagrams with cable, wire, tube and termination numbers. Coordinate all drawings with the conductor identification requirements in Section 16120 and Section 16124. Submit a copy of CAD produced drawings on magnetic media in AutoCAD DWG format.

E. Operation and Maintenance Manuals: Furnish Operation and Maintenance Manuals, including Instruction Manuals and Part Lists, for equipment provided under Division 17 as required by Division 1. Obtain data from manufacturers, and format and bind as specified. Obtain distribution method instructions from the Owner or his representative.

1. Schedule: Deliver at least two (2) copies of manuals in 3-ring binders (8-1/2 by 11-inch format) not later than the equipment shipment date.
2. Contents: Include in manuals not less than the following information, as applicable, for each instrument, equipment, subsystem and/or control loop:
 - a. General, introduction and overall description, purpose, functions, simplified theory of operations, etc.
 - b. Specifications (including equipment specification data sheet as described above under Shop Drawings), sufficiently detailed for reordering exact duplicates of the original items.
 - c. Installation instructions, procedures, sequences, tolerances, and precautions.
 - d. Operational procedures.
 - e. Shutdown procedures.

- f. Maintenance, calibration, and repair instructions.
 - g. Parts list and spare parts recommendations.
 - h. Calibration curves, rating tables, and any other data showing the relationship of the variable inputs and the calibrated output of all measuring devices and controlled equipment.
3. Format:
 - a. Use drawings and pictorials to illustrate the text to the extent necessary to insure a clear, concise presentation. If manuals have been written to cover a family of similar instruments or equipment, strike out inapplicable information in a neat fashion or emphasize applicable portion by heavily weighted arrows, circles or boxes; whichever provides the clearest and neatest presentation.
 - b. Group manuals by system control panels, including field instrumentation connected or associated with the panel. Where identical instruments are used in more than one control loop or subsystem, include only one instruction manual, per panel grouping; however, an index by tag number for all instruments shall identify its location in that manual.
 - c. Provide control loop and/or subsystem operational descriptions to identify the function of each instrument and its relation to the other instruments in the loop.
4. Binding: Bind each manual in a cover which indicates the panel or process area to which it applies, manufacturer's name, local address and telephone number, and year of purchase. Punch and bind manuals in standard three ring binders and include system name and subcontractor's name on binding.

F. Accessory and Maintenance Materials: Submit data for the following items:

1. Special Tools and Accessories: Special tools, instruments, and accessories for maintaining instruments and equipment requiring periodic repair and adjustment as specified elsewhere herein. Also, furnish special lifting and handling devices for equipment requiring such devices.
2. Maintenance Materials and Spare Parts: Submit a list of manufacturer's recommended spare parts for each item specified. Refer to other sections of these Specifications.

G. Test Reports: Submit the following test reports as described herein:

1. Instrument Calibration Data Sheets (paragraph 2.12)
2. Factory Testing of Control Panels ((paragraph 2.13)
3. Instrument Verification Report ((paragraph 3.07.B)
4. Final Operational Testing ((paragraph 3.07.C)

- H. Demonstration and Final Operation Test Plan and Results: Submit a document that outlines all procedures to be used in final operational testing of instrument and control systems. Include a description of each system, the scope of testing, test methods and materials, testing instruments and recorders, a list of functional parameters to be recorded on each item, and Shop Drawings showing temporary bypasses, jumpers, and devices.

1.06 QUALITY ASSURANCE

- A. Standard of Quality: The Contractor shall provide equipment of the types and sizes specified which has been demonstrated to operate successfully. Provide equipment which is new and of recent proven design.

1.07 INSPECTIONS

- A. 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.
- B. Inspection of the equipment at the factory by the Engineer will be made after the manufacturer has performed satisfactory checks, adjustments, tests and operations.
- C. Favorable review of the equipment at the factory only allows the manufacturer to ship the equipment to the project site. The Contractor shall be responsible for the proper installation and satisfactory startup operation of the equipment to the satisfaction of the manufacturer and the Engineer.

1.08 DRAWINGS

- A. Drawings: The Instrumentation Drawings are diagrammatic; exact locations of instrumentation products shall be determined in the field by the Engineer. Except where special details are used to illustrate the method of installation of a particular piece or type of equipment or material, the requirements or descriptions in this Specification shall take precedence in the event of conflict.
1. Locations of equipment, inserts, anchors, motors, panels, pull boxes, manholes, conduits, stub-ups, fittings, power and convenience outlets, and ground wells are approximate unless dimensioned; verify locations with the Engineer prior to installation. Field verify scaled dimensions on Drawings.
 2. Review the Drawings and Specification Divisions of other trades and perform the instrumentation work that will be required for the installations.
 3. Should there be a need to deviate from the Instrumentation Drawings and Specifications, submit written details and reasons for all changes to the Engineer for favorable review.

4. Resolution of varying interpretations of the Contract Documents shall conform to Division 0, General and Supplementary Conditions.
5. The Drawings provide details of installation and supersede the manufacturer's recommendation where a conflict exists.

1.09 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Box, crate, or otherwise enclose and protect instruments and equipment during shipment, handling, and storage. Keep all equipment dry and covered from exposure to weather, moisture, corrosive liquids and gases or any element that could degrade the equipment. Protect painted surfaces against impact, abrasion, discoloration, and other damage. Notify the Engineer in writing in the event that any equipment or material is damaged. Obtain prior favorable review by the Engineer before making repairs to damaged products.

1.10 INSTRUMENT SCHEDULE

- A. The appended Schedule lists pertinent information about instruments identified for the contract. The Schedule is a comprehensive listing of devices but shall not be construed as a Bill of Materials or as a complete listing. For example, equipment procured as a packaged unit or assembled in the field to perform a standardized function (such as water seals) may contain instruments that are not listed. Upon request, a copy of the database can be provided. Refer to 17010A for instrument schedule.

PART 2 - PRODUCTS

2.01 MATERIALS AND STANDARD SPECIFICATIONS

- A. Provide instruments, equipment and materials suitable for service conditions and meeting standard specifications such as ANSI, ASTM, ISA, and SAMA. The intent of this Specification is to secure instruments and equipment of a uniform quality and manufacture throughout the plant. All instruments in the plant of the same type shall be made by the same manufacturer.

2.02 NAMEPLATES

- A. For each piece of equipment, provide a manufacturer's nameplate showing his name, location, the pertinent ratings and the model designation.
- B. Identify each piece of equipment and related controls with a rigid laminated engraved phenolic nameplate. Engrave nameplates with the inscriptions indicated on the Drawings and, if not so indicated, with the equipment name. Securely fasten nameplates in place using two stainless steel screws or, where favorably reviewed by the Engineer, with epoxy cement. Where no

inscription is indicated on the Drawings, furnish nameplates with an appropriate inscription furnished by the Engineer upon prior request by the Contractor.

- C. Each control device, including pushbuttons, control switches, and indicating lights, shall have an integral legend plate or nameplate indicating the device function. These shall be inscribed as indicated on the Drawings or as favorably reviewed by the Engineer.
- D. Provide CAUTION or SAFETY nameplates to alert operators of special conditions that may result in faulty equipment operations. Devices containing batteries that must be replaced periodically must be clearly identified. Nameplates are not required if the device senses and displays a low battery warning.

2.03 NAME TAGS

- A. All instrumentation and equipment items or systems shall be identified by name tags. Field equipment shall be tagged with the assigned instrumentation tag number listed in the Instrument Schedule.
- B. Name tags shall be stainless steel with engraved or stamped black characters of 3/16-inch minimum height. Tags shall be attached to equipment with a tag holder and stainless steel band with a worm screw clamping device. Use 20-gauge stainless steel wire where banding is impractical. For field panels or large equipment cases use stainless steel screws; however, such permanent attachment shall not be on an ordinarily replaceable part.

2.04 FIELD-MOUNTED EQUIPMENT

- A. All instrument and control equipment mounted outside of protective structures shall be equipped with suitable surge arresting devices to protect the equipment from damage due to electrical transients induced in the interconnecting lines from lightning discharges or nearby electrical devices. Protective devices used on 120 Vac inputs to field mounted equipment shall be secondary valve surge protectors conforming to the requirements of ANSI C62.1.

2.05 EQUIPMENT OPERATING CONDITIONS

- A. All equipment shall be rated for normal operating performance with varying operating conditions over the following minimum ranges:
 1. Electrical Power: 120 Vac $\pm 10\%$, 60 Hz, unregulated, except where specifically stated otherwise on the Drawings or in the Specifications, or when two-wire, loop-powered devices are specified.

2. Field Instruments:
 - a. Outdoor Areas:
 - 1) Ambient Temperature: +65°F to +95°F
 - 2) Ambient Relative Humidity: 5% to 100%
 - 3) Weather: Rain
 - b. Indoor Unheated Areas:
 - 1) Ambient Temperature: +65°F to +95°F
 - 2) Ambient Relative Humidity: 5% to 95%, non-condensing
 - c. Indoor Environmentally Controlled Areas:
 - 1) Ambient Temperature: +60°F to +95°F
 - 2) Ambient Relative Humidity: 10% to 90%, non-condensing

2.06 EQUIPMENT LOCATIONS

- A. Provide equipment and materials suitable for the types of locations in which they are located as defined under Division 16. All equipment specified for field mounting shall be weatherproof and splash proof as a minimum. If electrical or electronic components are contained within the equipment, they shall be housed in NEMA 3R gasketed cases, NEMA 4 cases, NEMA 4X in corrosive locations, and NEMA 7 in hazardous locations unless noted otherwise on the Drawings.

2.07 ANALOG SIGNAL INDICATED UNITS

- A. For all instruments with local or remote indicators, provide indicators scaled in actual engineering units, i.e., gallons per minute, feet, psi, etc., rather than 0 to 100%, unless noted otherwise on the Drawings or Instrument Schedule.

2.08 SIGNAL TRANSMISSION

- A. ANALOG:
 1. Signal transmission between electric or electronic instruments shall be 4 to 20 mA and shall operate at 24 Vdc. Signal output from all transmitters and controllers shall be current regulated and shall not be affected by changes in load resistance within the unit's rating. Where practical, milliamperes signals from the field shall be converted to a voltage signal at the external terminals of each panel, and all instruments within a panel shall be parallel wired.
 2. Nonstandard transmission systems such as impulse duration, pulse rate, and voltage regulated will not be permitted except where specifically noted in the Instrument Schedule or shown on the Drawings. When transmitters with nonstandard outputs do occur, their output shall be converted to 4 20 mA prior to transmission.

- B. Discrete: All alarm and status signals shall be 120 Vac unless specified otherwise on the Instrument Schedule. Proprietary data highway or serial bit transmissions such as RS232C shall be allowed to the extent shown on the Drawings.

2.09 PANEL/RACK/ENCLOSURE BAY POWER SUPPLIES

- A. Provide each main rack and/or enclosure bay with a separate isolation transformer to prevent ground loops between the instrument and electrical power grounds. These transformers may be nonshielded control power type.
- B. For each two-wire transmitter, provide a 24-Vdc regulated 50 mA power supply with 120-Vac input. Output voltage may be 24 Vdc $\pm 5\%$ manufacturing tolerance at no load, but shall hold within 1% from no load to full load at 120 Vac $\pm 10\%$ input. Line to-load regulation shall be within 0.1% from no-load to full load. Ripple shall be less than 15 mV peak-to-peak.
- C. Manufacturer: Provide Model AP9046 instrument loop power supply as manufactured by Action Instruments with plug-in mounting base, equivalent capacity Lambda power supply with terminal blocks for external connections or approved equal.

2.10 PAINTING

- A. Factory paint all instruments and equipment except where installed in pipelines. Where instrument panels are installed adjacent to electrical control panels provided under Division 16, provide instrument panels of identical color to that of electrical control panels. Paint as required in Division 9 for structural supports, brackets, etc. Repair damaged factory paint to satisfaction of the Engineer. Feathering, priming and painting shall produce a reasonable match to the surrounding paint work.

2.11 FASTENERS

- A. 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 3/8-inch.

2.12 INSTRUMENT CALIBRATION

- A. Each field instrument shall be calibrated at 0%, 25%, 50%, 75% and 100% of span using test instruments to simulate inputs and read outputs that are rated to an accuracy of at least five times greater than the specified accuracy of the

- instrument being calibrated. Such test instruments have accuracies traceable to the National Institute of Standards and Technology (NIST).
- B. Submit a written report to the Engineer on each instrument. This report shall include a laboratory calibration sheet or the manufacturer's standards calibration sheet on each instrument and calibration reading as finally adjusted within tolerances.
 - C. The Contractor may, at his option, choose to perform calibration on an instrument by acquiring the services of an independent test lab, or by obtaining the required test instruments and performing the calibration.

2.13 FACTORY TESTING OF CONTROL PANELS

- A. All fabricated equipment shall be tested before it leaves the factory. At the factory verify wiring continuity and equipment operation by simulating input and output.
- B. Factory testing of control panels/devices/equipment shall be accomplished. Refer to individual Specification sections for tests requiring favorable review.
- C. Upon completion of factory testing, submit a report certifying the control panels/devices/equipment are operable and meet the Specifications.

PART 3 - EXECUTION

3.01 MOUNTINGS

- A. Mount and install equipment as indicated. Mount field instruments on pipe mounts or other similar means in accordance with suppliers' recommendation. Where mounted in control panels, mount according to requirements of that section.
- B. Equipment specified for field mounting shall be suitable for direct pipe mounting or surface mounting, surface-mounted indicators and equipment with calibration adjustments or requiring periodic inspection shall be mounted not lower than 3 feet 6 inches nor higher than 6 feet above walkways, platforms, catwalks, and the like.
- C. Note that applicable specifications require detail drawings showing seismic sway bracing design and anchorage requirements for their equipment. Seismic zone requirements are specified in Division 1.
- D. All devices shall be accessible to operators for servicing, operating, reading, etc. Provide permanent platforms to assure devices are continuously accessible.

3.02 PROCESS CONNECTIONS

- A. Provide instrument impulse tubing (see Part 2) to meet the intended process service and ambient environmental condition for corrosion resistance, etc. Install impulse tubing with a continuous slope according to service to promote self-draining or venting back to the process. Terminate connection to process lines or vessels in a service rated roof valve, provided under other Divisions, that will permit closing off the impulse line or removal of the element without requiring shut down of the process. Include blowdown of drip legs and valves for terminations of impulse lines at the instruments.
- B. Process vessels, line penetrations, and root valves shall be furnished and installed under other Divisions of these Specifications. Instrument tubing and valve manifolds are installed as part of this Specification.

3.03 FIELD WIRING

- A. Ring out signal wiring prior to termination and perform surge withstand tests where required (see Section 16010 (26 05 00), Part 3 for methods). Verify wire number and terminations are satisfactory as designated on the Loop and Interconnect Diagrams. Verify all terminations are tight and shields are uniformly grounded at one location.

3.04 ELECTROMAGNETIC INTERFERENCE (EMI)

- A. Construction shall proceed in a manner which minimizes the introduction of noise (RFI/EMI) into the I&C System.
- B. Cross signal wires and wires carrying ac power or control signals at right angles.
- C. Separate signal wires from wires carrying ac power or switched ac/dc control signals within control panels, terminal cabinets, telemetry equipment, multiplexer cabinets, and data loggers as much as possible. Provide the following minimum separations within such equipment unless indicated otherwise on the Drawings:

Power Wiring Capacity	Separation (Inches)
120 volts ac or 10 amps	12
240 volts ac or 50 amps	18
480 volts ac or 200 amps	24
4,160 volts ac or 800 amps	48

3.05 SIGNAL GROUNDING

- A. Proper grounding of equipment and systems in this Division is critical, especially if or since computer and associated networks and peripherals are involved. The Drawings and Division 16, Section 16450, specify safety grounding for all equipment in this Division.
- B. A single-point grounding system for instrument signals is required for all instrument panels. This instrument single point grounding system does not use building steel or conduit systems for its ground path.
 - 1. Ground all signal shields, signal grounds, and power supplies at an isolated signal bus within each instrument panel, rack, or enclosure. See Section 17510 for isolated bus requirements. The shields at the far ends of these signal cables must be disconnected (floated) from any ground to prevent ground loops.
 - 2. Do not connect the rack or enclosure frames to the signal grounding buses.
 - 3. Connect each isolated signal ground bus within each panel using a stranded, insulated copper wire of size 6 AWG or larger directly to a system ground rod installed per the Drawings.
- C. If more than one instrument panel or rack is installed side-by-side, locate an isolated system grounding plate in one of the panels (see Section 17510 for requirements).
 - 1. Connect all the isolated signal buses in such instrument panel or rack radially to the system ground plate using a stranded, insulated copper wire of size 8 AWG or larger.
 - 2. Do not use conduit, cable raceways or building steel to distribute the grounding connections; use dedicated wires as specified above. Install a single conduit containing a #2 AWG insulated ground wire from the insulated grounding plate directly to a system ground rod installed per the Drawings. See Division 16 for conduit requirements.

3.06 PREPARATION

- A. Ensure that installation areas are clean and that concrete or masonry operations are completed prior to installing instruments and equipment. Maintain the areas in a broom-clean condition during installation operations.
- B. Panels shall be protected during construction to prevent damage to front panel devices and prevent dust accumulation in the intervals. Other protective measures (lamp, strip heaters, etc.) shall be included as weather conditions dictate.

3.07 FIELD TESTING

- A. General: The purpose of the field testing is to verify instruments are calibrated and operationally performing their intended function. Provide the services of factory trained and experienced engineers to perform verification and operational testing as prescribed below. Since the initial calibration of instruments may not satisfy the final operation of system, perform recalibration or adjust setpoints as required to satisfy the performance requirements of the system. Notify the Engineer and Owner in writing a minimum of 48 hours prior to the proposed date for commencing final operational testing and acceptance.
- B. System Verification Testing: Verify that each instrument shown on the Instrument Schedule is operating and calibrated as specified in the Instrument Schedule by simulating inputs at the primary element in each system loop and verify performance at loop output devices (i.e., recorder, indicator, alarm, etc., except controllers). Simulate inputs at 0%, 25%, 50%, 75%, and 100% of span or with on-off inputs, as applicable. During system verification:
 1. Make initial or provisional settings on levels, alarms, etc. listed in the Instrument Schedule.
 2. Verify controllers by observing that the final control element moves in the proper direction to correct the process variable as compared to the set point.
 3. Cause malfunctions to sound alarms or switch to standby to check system operation.
 4. Check all loop instruments thoroughly for correct operation.
 5. Immediately correct all defects and malfunctions disclosed by tests.
 6. Submit a report certifying completion of verification of each instrument system. This report shall include a data sheet on each instrument tested that indicates instrument tolerances, instrument calibration verification, data and initial settings made to devices.
- C. Final Operational Testing: Upon completion of instrument verification, test all systems under process conditions in the presence of the Owner or designated representative. System testing shall be accomplished in accordance with the approved Test Plan (Paragraph 1.07I) The test for each portion thereof shall be witnessed, documented and signed off upon completion by the Engineer. The intent of this test is to demonstrate and certify the operational interrelationship of plant instrumentation and control systems. This testing shall include, but not be limited to:
 1. Making final adjustments to levels, alarms, etc.
 2. Optimum tuning of controllers.
 3. Checking all alarms, failure interlocks, and operational interlocks.

4. Verifying all computer input and outputs and CRT displays are fully functional.
5. Verifying automatic computer-generated reports are performing satisfactorily.
6. Immediately correcting all defects and malfunctions and retesting.
7. Submit the witnessed test results and a transmittal letter indicating that all required systems have been tested satisfactorily and the systems meet all the functional requirements of their applicable specifications.

3.08 INSTRUCTION OF OWNER'S PERSONNEL

- A. Provide the services of a factory-trained and field experienced instrumentation engineer to conduct group training of up to five of the Owner's designated personnel in the operation of each instrument system. This training shall be for the time period of five working days and shall be performed during the operational testing period. Include instruction covering basic system theory, operating principles and adjustments, routine maintenance and repair, and "hands on" operation. The text for this training shall be the Operation and Maintenance Manuals furnished under these Specifications.

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SECTION 17010A

APPENDIX A INSTRUMENT SCHEDULE

THIS LIST MAY INCLUDE VENDOR SUPPLIED INSTRUMENTS. REFER TO P&IDS

Tag #	Description	Range	Alarm Setpoint	P&ID	Spec Section	DESCRIPTION
LSHH-101	LEVEL SWITCH HIGH HIGH		Mount so float activates at elevation = -0.5 ft.	I-8	17140	
LT-100	LEVEL TRANSMITTER	0 to 10 ft.	Per 17330A	I-8	17140 and 1733A	
PI-100	PRESSURE INDICATOR ON PUMP DISCHARGE			I-8	17150	
PI-200	PRESSURE INDICATOR ON PUMP DISCHARGE			I-8	17150	
PI-300	PRESSURE INDICATOR ON PUMP DISCHARGE			I-8	17150	
PIT-400	PRESSURE TRANSMITTER			I-8	17150	
FIT-400	MAG FLOW METER			I-8	17120	
ZS-100	CP INTRUSION SWITCH			I-9	17170	
ZS-101	GENERATOR INTRUSION SWITCH			I-9	17170	
ZS-102	ELECTRICAL INTRUSION SWITCH			I-9	17170	
LSH-002	DIESEL FUEL STORAGE TANK LEAK			I-9	N/A	VENDOR PROVIDED
LT-001	DIESEL FUEL STORAGE TANK LEVEL			I-9	N/A	VENDOR PROVIDED
LT-002	DIESEL FUEL TANK LEVEL			I-9	N/A	VENDOR PROVIDED
LSH-003	DIESEL FUEL TANK LEAK			I-9	N/A	VENDOR PROVIDED

Notes:

1. Instrument Schedule is not intended to represent a bill of material or a complete list of all required instruments.
2. Settings indicated are considered "Initial Settings." Final settings shall be accomplished in field to suit actual operating conditions.
3. Owner furnished equipment (OFE). Contractor to install OFE.

END OF SECTION

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SECTION 17120

FLOW MEASUREMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Requirements of Division 01 and Sections 17010 and 11001 form a part of this Section. This Section specifies flow measurement devices for process instrumentation, auxiliary equipment, and supplies directly related to the installation of and operation of these flow measurement devices, to perform the required functions in conjunction with information and equipment specified in other sections of Division 17.
- B. Provide all instruments identified in the Contract Drawings.

1.02 SUBMITTALS

- A. Shop drawings and product data to be submitted in this Section shall be made in one package under the Product Review Category of Shop Drawings.
- B. Shop Drawings and Product Data:
 1. In addition to the requirements of Section 17010, shop drawings shall include for each type of instrument: supply voltage and frequency, electrical load, accuracy, description of operation, operating instructions, and calibration procedure.
 2. Furnish Shop Drawings and Product Data for each item of mechanical equipment presenting sufficient data to determine compliance to these Specifications. Submit completed ISA S20 forms for each device and physical dimensions. Also submit manufacturer's recommended upstream and downstream straight piping lengths, recommended location of any pressure taps, and estimates of pressure losses through the device.
- C. Installation Method: The proposed method of mounting sensors and instruments shall accompany all shop drawings.
- D. Parts List: Submit a Parts List with current net prices and a list of recommended spares.
- E. Factory Testing and Calibration:
 1. All meters shall be factory tested. Perform a factory test and/or provide certification of calibration from an independent test laboratory. Calibration curves based on factory and/or laboratory testing (see option below) shall be provided for the Engineer's favorable review. Furnish calibration curves in units of output (inches or rpm/gpm) versus measured flow. Upon receipt of the Engineer's favorable review, the Contractor may have the meters shipped to the job site.

2. As an option to laboratory testing each meter, the calibration curves of six (6) "like devices" may be substituted provided the calibration data is available from at least one identical device (pipe size, flow range, and type plus accessories such as extension registers).
 3. The flow tube supplier shall provide laboratory calibration data to the transmitter supplier or, where practical, test the flow tube and transmitter as an integral assembly. The integral test shall be accomplished at no extra cost to the customer.
- F. Manuals: Furnish manufacturer's installation, lubrication, operation and maintenance manuals, bulletins, and spare parts lists.
- G. Affidavits: Furnish affidavits from the manufacturers stating that the meters have been properly installed and tested and each is ready for full time operation.

1.03 QUALITY ASSURANCE

- A. Manufacturer: In addition to the requirements of Section 17010, flow measurement devices furnished shall be manufactured by firms regularly and currently engaged in the design and manufacture of similar equipment. All equipment furnished shall be new and of current design.
- B. Maintainability: All equipment shall be designed for ease of maintenance and repair, and access to critical parts shall not require a major disassembly. Internal field adjustments where permitted or required herein shall be easily accessible upon removal of a panel or cover.
- C. Materials and Installation: Materials and installation shall comply with the requirements of the current editions of referenced electrical codes and standards, and the codes and standards referred to shall be used for establishing the minimum quality of the materials and equipment supplied and installed. All equipment of the same type shall be products of the same manufacturer. Capacities of all equipment shall not be less than that indicated on the Drawings or as specified.
 1. Provide instruments suitable for the site conditions including, but not limited to, ambient temperatures, altitude, humidity, material compatibility, and process conditions.

1.04 SEISMIC PROTECTION

- A. Seismic restraint for metering devices, which are integral with piping, shall be as specified for the piping system in which they are installed. Seismic design certification and anchorage descriptions are required by 01190.

1.05 INDICATING UNITS

- A. Provide flow indication in engineering units (GPM, CFS, MGD, etc.). Indicators which read 0 to 100%, 4-20 mA, etc. shall not be acceptable.

1.06 SERVICE CONDITIONS

- A. Provide process fluid description that includes type of liquid or gas, pH, density, viscosity, suspended solids concentration, temperature, mixed liquid/gas, or air entrainment to support flow device materials. Consider flow device applications in:
 - 1. Water

1.07 SPECIAL WARRANTY

- A. Provide an extended warranty not less than 3 years from the manufacturer for all induction type magnetic flowmeters furnished as part of the contract.

PART 2 - PRODUCTS

2.01 MAGNETIC FLOWMETER - INDUCTION TYPE

- A. General: Magnetic meters shall utilize the principle of electromagnetic induction to produce an output proportional to the rate of fluid flow. A set of pulsed dc, electrically powered coils shall generate a magnetic field, which in turn induces a voltage in the flowing fluid, which is sensed by a pair of electrodes in contact with the fluid.
 - 1. Protect coils from contact with the fluid. Two (min) self-cleaning electrodes type and material shall be in conformance with Manufacturer's recommendations for the intended service. Flow tubes mounted above finished floor shall be rated NEMA 4X, and all flow tubes mounted below grade or in vaults shall be rated NEMA 6P. The metering tube shall be lined in conformance with Manufacturer's recommendations for the intended service. The probe sensor shall be designed to be inserted in sewage water pipes and shall not be affected by solids, air bubbles, oil, or coating. The spool shall have ANSI Class 150 flanges or Class 300 flanges when the process exceeds the rating of the 150-pound flange. Flange type shall be coordinated with the mechanical contractor prior to submittal.
 - 2. The meters shall be designed to operate from a 120 volt ac, 60 cycle, single phase power supply. A 10% variation in power line voltage or frequency shall not affect the meter output accuracy in excess of 0.25% of full scale.
 - 3. Provide magnetic flowmeters suitable for fluids with conductivities as low as 5.0 micromho/cm.
 - 4. Each magnetic flow meter system shall have an accuracy within 1% of actual for flow velocities between 10% and 100% of full scale. Meters shall have a repeatability within 0.25% of full scale.
 - 5. Each magnetic flow meter shall be equipped with a signal converter to transmit an analog 4-20 mAdc signal. Output span and zero shall be manually adjustable. Provide span adjustment capable of producing 100% strength analog at flow rates 30 feet/second. Signal shall be linear with flow within the accuracy specified above. The converter shall be

- integrally mounted within the meter housing or shall be capable of being mounted remotely up to 300 feet as shown on the Drawings.
- 6. The transmitter shall have a positive zero return output for flow conditions less than 0.02 foot/second.
 - B. Grounding: Provide a grounding circuit for each magnetic meter. Furnish and install grounding rings or protective shield when meter is installed in nonconductive line.
 - C. Cathodic Protection: Provide isolation gaskets and insulating flange bolt bushings and washers when installed on cathodically protected piping.
 - D. Special Tools: Furnish special tools, which are necessary for the replacement of parts and the adjustment of the equipment.
 - E. Manufacturer: Endress+Hauser Promag W400; ABB WaterMaster; Siemens, or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Provide installation, testing, calibration, verification, and startup instructions in accordance with Sections 15050 and 17010. Coordinate the installation with all trades to ensure the mechanical system is proper for the instrument.
- B. Startup Assistance and commissioning shall be provided by a factory certified representative.
- C. Where instruments are located outdoors provide surge protectors at the transmitters. Provide isolators, relays, conditions, or other devices as required for a functional system.
- D. Instruments without approved submittals shall not be installed.
- E. The Contract Drawings and Specifications are intended show basic functional requirements. Insufficient detail does not relieve the Contractor from the responsibility to provide a complete and functioning system.

3.02 FIELD TESTING

- A. The installation shall be examined to verify the instrument will work properly when installed and the Engineer promptly notified if it does not meet manufacturer recommendations or the Specifications.
- B. Verify factory calibration of instruments in accordance with the manufacturer's instructions.
- C. All instrumentation calibration and configuration shall be completed prior to the start of field testing.
- D. Totalizer tests are not to be performed in the field.

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SECTION 17140

LEVEL MEASUREMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Provisions: Requirements of Division 1 and Section 17010 form a part of this Section.
- B. Work Included: Level measurement devices for process instrumentation, auxiliary equipment and supplies directly related to the installation of and operation of these level measurement devices, to perform the required functions in conjunction with information and equipment specified in other sections of Division 17. Refer to the Instrument Index in Section 17010 for a listing of required devices.

1.02 SUBMITTALS

- A. Shop drawings to be submitted in this Section shall be made in one package under the Product Review Category of Shop Drawings.
- B. Shop Drawings: In addition to the requirements of Section 17010, shop drawings shall include for each type of instrument: supply voltage and frequency, electrical load, accuracy, description of operation, operating instructions, and calibration procedure.
- C. Installation Method: The proposed method of mounting sensors and instruments shall accompany all shop drawings.
- D. Parts List: Submit a Parts List with current net prices and a list of recommended spares.

1.03 QUALITY ASSURANCE

- A. Manufacturer: In addition to the requirements of General Requirements, level measurement devices furnished shall be manufactured by firms regularly and currently engaged in the design and manufacture of similar equipment. All equipment furnished shall be new and of current design.
- B. Maintainability: All equipment shall be designed for ease of maintenance and repair, and access to critical parts shall not require a major disassembly. Internal field adjustments where permitted or required herein shall be easily accessible upon removal of a panel or cover.

- C. Materials and Installation: Materials and installation shall comply with the requirements of the current editions of referenced electrical codes and standards, and the codes and standards referred to shall be used for establishing the minimum quality of the materials and equipment supplied and installed. All equipment of the same type shall be products of the same manufacturer. Capacities of all equipment shall not be less than that indicated on the Drawings or specified.

PART 2 - PRODUCTS

2.01 SUBMERSIBLE LEVEL TRANSMITTER

- A. General: This type of level transmitter shall be intrinsically safe and specifically designed for use in submerged wastewater applications designated as Class 1, Division 1.
- B. Specific Requirements: The type of process medium, temperature range, pressure other than atmospheric, measurement range, output type, indicators, switches, characterization and other requirements shall be as specified in the Schedule. Unless otherwise specified, the accuracy shall be $\pm 0.2\%$ of full scale and less than $0.015\%/\text{°F}$ drift. The transmitter shall have direct air pressure and temperature compensation and have less than 0.1% drift during the first year of operation.
- C. CONSTRUCTION:
1. The level transmitter shall have a ceramic diaphragm in an iron rod reinforced NEMA 6P polypropylene and POM housing.
 2. The level transmitter shall have an oil-resistant PVC jacketed 2xAWG-20 wire shielded cable with a 2000-lb. pull strength.
 3. The level transmitter shall be UL certified and approved for use in Class 1, Division 1, Groups A-D hazardous atmospheres.
 4. The level transmitter shall produce a linear 4-20 mA signal, proportional to the measured level and capable of transmission over a maximum 600-ohm loop resistance.
 5. The level transmitter shall have a minimum operating temperature range from 14 to 158°F.
 6. The level transmitter shall produce a linear 4-20 mA signal proportional to the measured level, and capable of transmission over a maximum 600-ohm loop resistance.
 7. Manufacturer to supply mounting hardware.
- D. Power: The level transmitter shall be 10-29 VDC loop powered.
- E. Manufacturer: Submersible level transmitter shall be as manufactured by MJK, Model 3400 Hydrostatic Level Transmitter; no equal.

2.02 LEVEL SWITCH - FLOAT TYPE, SUMP DUTY

- A. General: Level switch shall use the movement of a float, the weight of whose moving parts is less than that of the displaced process liquid, to actuate switches as the level changes. The switch(es) shall be integrally mounted within the float and connected to a terminal box by a waterproof electric cable. A movable weight shall be mounted on the cable to keep the cable immersed in the liquid.
- B. The switch operating levels shall be easily adjusted by moving the weight along the cable or altering the height of the cable fixing point.
 - 1. The switch covering shall be made of indestructible polypropylene material. The cable shall be PVC coated.
 - 2. The switches shall be reversible such that the switching action operates on rising or falling level.
 - 3. The switch actuating points shall be as listed in the Instrument Index.
 - 4. The float shall be rated for 150 psi (10.5 kg/cm²) pressure and 140°F (60°C) temperature. The float shall not be greater than 7 inches (178 mm) in diameter.
 - 5. The switches shall be rated for 250 volts ac or dc and 5 amperes minimum and shall be terminated with 14 AWG wires in a NEMA 4X terminal box.
 - 6. Provide intrinsically-safe relays (IR) for switches used in hazardous locations where shown on the Drawings.
- C. Manufacturer: Float type sump level switches shall be as manufactured by MJK, Flygt Corporation; Consolidated Electric Company; or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Installation, testing, calibration, validation, startup and instruction shall be in accordance with Section 17010.

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SECTION 17150
PRESSURE MEASUREMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES:

- A. Requirements of Division 1 and Section 17010 form a part of this Section. This Section specifies pressure measurement devices for process instrumentation, auxiliary equipment and supplies directly related to the installation of and operation of these pressure measurement devices, to perform the required functions in conjunction with information and equipment specified in other sections of Division 17. Refer to the Instrument Index in Section 17010 for a listing of required devices.

1.02 SUBMITTALS

- A. Shop drawings to be submitted in this section shall be made in one package under the Product Review Category of Shop Drawings.
- B. Shop Drawings: In addition to the requirements of Section 17010, shop drawings shall include for each type of instrument: supply voltage and frequency, electrical load, accuracy, description of operation, operating instructions, and calibration procedure.
- C. Installation Method: The proposed method of mounting sensors and instruments shall accompany all shop drawings.
- D. Parts List: Submit a Parts List with current net prices and a list of recommended spares.

1.03 QUALITY ASSURANCE

- A. Manufacturer: In addition to the requirements of Section 17010, pressure measurement devices furnished shall be manufactured by firms regularly and currently engaged in the design and manufacture of similar equipment. All equipment furnished shall be new and of current design.
- B. Maintainability: All equipment shall be designed for ease of maintenance and repair, and access to critical parts shall not require a major disassembly. Internal field adjustments where permitted or required herein shall be easily accessible upon removal of a panel or cover.
- C. Materials and Installation: Materials and installation shall comply with the requirements of the current editions of referenced electrical codes and standards, and the codes and standards referred to shall be used for

establishing the minimum quality of the materials and equipment supplied and installed. All equipment of the same type shall be products of the same manufacturer. Capacities of all equipment shall not be less than that indicated in the Instrument Index.

PART 2 - PRODUCTS

2.01 PRESSURE GAUGES

- A. Pressure Gauges: Pressure gauges shall be of the local mounting type unless panel mounted type is shown on the Drawings.
- B. CONSTRUCTION:
 - 1. Gauges shall be of the bourdon tube or bellows type with 270 degrees C.W. pointer travel. Dials shall be white with black numerals. Panel-mounted gauges shall have round bezels for flush mounting and rear connection. Others shall have a stem mounting bottom connection, cast iron case, plastic lens, and blowout protection. Accuracy shall be 1% of full-scale maximum and readable to 1%. Connection for all gauges shall be male 1/4-inch NPT with square wrench flats. Provide diaphragm seals on corrosive fluid and gas lines and those lines having large amounts of
 - 2. Refer to Section 15050 for additional requirements for snubbers, dampening, pressure limiting, and material requirements.
- C. Manufacturers: The gauges shall be a product of Ashcroft, U.S. Gauge, or approved equal.

2.02 PRESSURE TRANSMITTERS – ELECTRONIC

- A. Pressure Transmitters: Pressure transmitters shall be of the local mounting type unless panel mounted type is shown on the Drawings.
- B. CONSTRUCTION: The Transmitter enclosure shall be NEMA 4X rated except where explosion-proof is required. Enclosure and wetted surface material shall be corrosion resistant and suitable for the process fluid.
- C. Manufacturers: Emerson/Rosemount 3051 series; Endress+Hauser Cerabar series; or equal.

2.03 ANNULAR SEALS (PRESSURE SENSOR RINGS)

- A. General:
 - 1. Pressure sensor rings are to be of the full flange design, to be retained between standard ANSI B16.1 Class 125/6.5 Class 150 pipeline flanges. Flange bolts shall pass through sensor body and flanges. The outside

- diameter of the sensor shall match the outside diameter of the mating flange. Face-to-face of the entire sensor shall be no longer than specifications MSS-SP67.
2. Sensor shall be flow through design with flexible elastomer sensing ring around the full circumference. The elastomer sensing ring shall be rigidly clamped between metal end cover flanges, and no part of the elastomeric sensing ring shall be exposed to the external face of the sensor. There shall be no dead ends or crevices and flow passage shall make the sensor self-cleaning.
 3. The pressure sensing ring shall measure pressure for 360 degrees around the full inside circumference of the pipeline. Flexible sensing ring shall have a cavity behind the ring filled with fluid to transfer pressure to the gauge. Sensor ring shall be manufactured in the USA.

B. Function:

1. Line pressure pushes against an elastomer ring inside the sensor. The deflection of the ring displaces a fluid fill inside the body of the sensor, forcing the fluid into a pressure-measuring device.

C. Manufacturer:

1. Sensor rings shall be of the Series 40 as manufactured by the Red Valve Co., Inc. of Carnegie, PA or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. On systems requiring diaphragm seals, the Contractor shall order (or assemble) a completely filled system. The filling fluid shall be silicone oil [or glycerin]. Interconnecting piping shall be kept short. The filled system shall retain the same calibration requirements of the individual components.
- B. Installation, testing, calibration, validation, startup and instruction shall be in accordance with Section 17010.

END OF SECTION

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SECTION 17170

POSITION AND MOTION MEASUREMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. Requirements of Division 1 and Section 17010 form a part of this Section. This Section specifies position and motion measurement devices, auxiliary equipment and supplies directly related to the installation of and operation of these position and motion measurement devices, to perform the required functions in conjunction with information and equipment specified in other sections of Division 17.

1.02 SUBMITTALS

A. SHOP DRAWINGS:

1. Shop drawings to be submitted in this Section shall be made in one package under Product Review category of shop drawings.
2. In addition to the requirements of Section 17010, shop drawings shall include for each type of instrument: physical dimensions, supply voltage and frequency, electrical load, accuracy, description of operation, operating instructions, and calibration procedure.
3. All shop drawings, catalog pages, and cut sheets shall be clearly marked with the unique tag for the instrument(s) to which they apply.
4. Shop drawings shall include a completed ISA S20 form for each device.
5. Installation Method: The proposed method of mounting sensors and instruments shall accompany all shop drawings.

B. MANUALS:

1. Submit manuals in accordance with the requirements of Section 17010.
2. ISA S20 forms: Include a completed final S20 form for each device with the manuals. S20 forms shall be updated to include final values or notes from testing, startup, and commissioning.
3. Parts List: Include a parts list showing current net prices and a list of recommended spares with the manuals.

1.03 QUALITY ASSURANCE

- A. Manufacturer: In addition to the requirements of Section 17010, position and motion measurement devices furnished shall be provided from manufacturers regularly and currently engaged in the design and manufacture of similar equipment. All equipment furnished shall be new and of current design.

- B. **Maintainability:** All equipment shall be designed for ease of maintenance and repair, and access to critical parts shall not require a major disassembly. Internal field adjustments where permitted or required herein shall be easily accessible upon removal of a panel or cover or through use of an external handheld device.
- C. **Materials and Installation:** Materials and installation shall comply with the requirements of the current editions of referenced electrical codes and standards, and the codes and standards referred to shall be used for establishing the minimum quality of the materials and equipment supplied and installed. All equipment of the same type shall be products of the same manufacturer. Capacities of all equipment shall not be less than that indicated on the Instrument List.

PART 2 - PRODUCTS

2.01 INTRUSION SWITCHES – LIMIT TYPE

- A. Limit switches used for intrusion detection shall be heavy duty snap action type, with the following features:
 1. Metal body
 2. -20°F to 185°F temperature operating range
 3. Single-pole, double-throw
 4. Spring return
 5. 600V class contacts
 6. NEMA enclosure rated for the environment in which the switch is installed.
 7. 1/2-inch NPT conduit entry
 8. Provide lever arm where required.
- B. **Manufacturer:** Schneider Electric Series 9007CR, Eaton E50 Series, or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Installation, testing, calibration, validation, startup, and instruction shall be in accordance with Section 17010.
- B. Provide brackets as needed and adjust location of intrusion switches in the field for proper operation with the hatch, door, or cover with which they are used.

END OF SECTION

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SECTION 17200

PANEL-MOUNTED AND MISCELLANEOUS INSTRUMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Provisions: Requirements of Division 1 and Sections 17010 and 16955 form a part of this Section.
- B. Work Included: This Section specifies the panel mounted and miscellaneous field instruments and equipment to perform the required functions in conjunction with information and equipment specified in other sections of Division 17. Refer to the Instrument Schedule in Section 17010 for a list of required devices. This Schedule shall not be construed as complete bills of material.
- C. Unit Responsibility: It shall be the responsibility of the qualified single firm as described in Section 17010 of this Division to ensure that the instruments and equipment furnished under this Section are compatible with the equipment furnished under sections of this Division and other Divisions of these Specifications, and that the signal transmission methods are compatible.
- D. Control and Performance Terminology used hereinafter in this Section shall be as defined in SAMA Standard PMC20-2-1970, "Process Measurement and Control Terminology."
- E. Cases: Cases of front of panel mounted instruments shall be of uniform design and color scheme wherever possible. Front of case colors shall be compatible with panel colors, subject to final approval by the Owner. Normally, compatible standard colors of the manufacturer shall be acceptable.
- F. PANEL MOUNTED EQUIPMENT:
 1. All flush mounted miniature electronic controllers, recorders, and stations shall be a matching style family of instruments utilizing multiple-unit mounting cases and back of panel plug-in cable connections.
 2. All front panel mounted instruments shall be capable of withdrawing chassis to all service and test positions without affecting operation, and complete removal by a single plug connection from the front.
 3. All back of panel-mounted signal conditioners and auxiliaries shall be mounted in plug-in card files with labeled adjustment and test point at front of card edge.

4. All instruments shall accept 4-20 mAdc or 1 to 5 Vdc input signals and shall produce 4-20 mAdc or 1 to 5 Vdc output signals as specified in the Schedules. Internal panel signals may be of either type. All signals coming to or leaving the panel shall be 4-20 mAdc.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Panels: Section 17510.

1.03 SUBMITTALS

- A. Shop drawings to be submitted in this section shall be made in one package under the Product Review Category of Shop Drawings.
- B. Refer to Section 17010 for additional submittals required for each item herein.

1.04 QUALITY ASSURANCE

- A. Manufacturer: In addition to the requirements of Section 17010, instrumentation and control equipment furnished shall be manufactured by firms regularly and currently engaged in the design and manufacture of similar equipment. All equipment furnished shall be new and of the most recent design. Except where specified otherwise, the instruments furnished under this Section shall be as manufactured by Precision Digital Corporation; Ametek/Power Instruments; or approved equal.
- B. Maintainability: All equipment shall be designed for ease of maintenance and repair, and access to critical parts shall not require a major disassembly. Internal field adjustments where permitted or required herein shall be easily accessible upon removal of a panel or cover.
- C. Materials and Installation: Materials and installation shall comply with the requirements of the current editions of referenced electrical codes and standards, and the codes and standards referred to shall be used for establishing the minimum quality of the materials and equipment supplied and installed. All equipment of the same type shall be products of the same manufacturer. Capacities of all equipment shall not be less than that indicated on the Drawings or specified.

PART 2 - PRODUCTS

2.01 PROCESS VARIABLE INDICATORS

- A. Single or dual channel process variable indicators shall have a dual line display at least 6 digits long, shall have a reference accuracy of $\pm 0.05\%$ or better, and the indicating pointer shall be driven by the output of a solid state

- electronic amplifier. Zero and span adjustment shall be provided. Indicating scale graduations shall be readable to 1% of full scale. Input signal shall be 4-20 mA as indicated on the P&IDs.
- B. Digital Indicators shall be provided where indicated and shall display the decimal value of a numerically coded input. Accessories shall be provided to accept analog voltage or current inputs, or other digitally coded inputs as specified in the Instrument Schedule. The number and size of the digits shall be as specified. The displayed digits shall be luminous and easily visible in a well-lighted control room. The display style shall be the choice of the I&C Subcontractor, except that all displays shall be of the same style. The accuracy of the display shall be within \pm one digit but not less than $\pm 0.1\%$ for analog inputs. There shall be no error with digital inputs. Automatic ranging and polarity selection and sign indication shall be provided.

- C. Four SPDT (Form C) relays rated 3 A @ 120 VAC.
- D. Power Input: 120 VAC, 20.
- E. Manufacturer: Precision Digital Corporation PD6000; or approved equal.

2.02 ANNUNCIATOR PANELS

- A. Self-contained 10-alarm point consisting of ten 120 VAC dry contacts. Alarm points are defined in the project plans.
- B. Annunciator shall be flush mounted to the door of the control panel and be UL Listed. Displays consist of LED illumination.
- C. The alarm or status inputs shall be contacts or as shown on the Drawings. The Annunciator shall accept either N.O. or N.C. contacts. The sensing voltage shall be 120 Vac.
- D. There shall be a test button, acknowledge button, and reset button.
- E. Test button shall actuate all alarm and status points. The unit shall operate from 120 Vac, 60-Hertz commercial power.
- F. The annunciator panel shall be by Ametek Panalarm Model 910 or approved equal.

2.03 CONTROL PANEL ACCESSORIES

- A. Relays, timers and other internally mounted equipment shall be of the types specified in other sections of these Specifications.

- B. Panel face mounted equipment shall be of the types specified in other sections of these Specifications.
- C. Standards: All control devices shall conform to applicable provisions of NEMA Standards ICS 1 and ICS 2.
- D. Pushbuttons, selector switches and pilot lights shall be heavy-duty oiltight units. Pushbuttons and selector switches shall have contacts rated 10 amperes continuous, Rating Designation A600 in conformance with NEMA ICS 2.
 - 1. Pushbuttons used as emergency stop devices shall have a padlockable means for maintaining an open circuit. Indicating lights shall be push-to-test transformer type with lenses of the colors shown on the Drawings.
 - 2. Multiposition control switches shall have rotary action, round knurled handle and the number of positions and stages shown on the Drawings. They shall be suitable for panel mounting. Each position shall have a positive detent. Contacts shall have a continuous current rating of 10 amperes at 300 Vac. Switches shall have integral indicator.
 - 3. For 4-20 mAdc and 1 to 5 Vdc signal selector switches, provide oiltight selector switches with electronic duty gold contact blocks. Provide sliding contacts for reliable operation without benefit of thermal cleaning action.
 - 4. Manufacturer: Provide Microswitch heavy duty oiltight manual controls, Type PT, with electronic duty gold contact blocks; Allen-Bradley Bulletin 800T oiltight selector switch with stackable "Logic-Reed" contact blocks; or approved equal.

E. COLORS AND DESCRIPTIONS:

- 1. Indicating Lamps: Unless otherwise noted in the individual Loop Specifications, the following color code and inscriptions shall be followed for the lenses of all indicating lights and annunciators.

Indicating Lamp Inscription	Color	Annunciator Lamp Inscription
ON/START	Green	Refer to Panel Elevation Drawings and Elementary Drawings
ALARM	Amber	
FAIL	Red	

- 2. Lettering shall be black on white and amber lenses. Lettering shall be white on red and green lenses.
- 3. Pushbuttons: Follow color coding for indicating lamp above. All unused or noninscribed buttons shall be black. Lettering shall be black on white and yellow buttons. Lettering shall be white on black, red and green buttons.

- F. Nameplates: Unless specified otherwise in the Drawings, nameplates shall be black Iamacoid with minimum 3/16-inch-high white letters for major area titles, 5/32-inch for component titles, and 1/8-inch for subtitles, and shall be fastened with a permanent but dissolvable adhesive or by screws.

2.04 INSTRUMENT LOOP POWER SUPPLIES

A. GENERAL:

1. For each two-wire transmitter, provide a 24-Vdc regulated 50 mA power supply with 120-Vac input. Output voltage may be 24 Vdc $\pm 5\%$ manufacturing tolerance at no load but shall hold within 1% from no load to full load at 120 Vac $\pm 10\%$ input.
2. Line-to-load regulation shall be within 0.1% from no-load to full load. Ripple shall be less than 15 mV peak-to-peak.

B. Manufacturer: Provide Model AP9046 instrument loop power supply as manufactured by Action Instruments with plug-in mounting base; equivalent capacity Lambda power supply with terminal blocks for external connections; or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Installation, testing, calibration, verification, startup and instruction shall be in accordance with Section 17010.
- B. Wiring: Refer to Section 17010, Part 3.
- C. Switching Circuit Schematics: Schematics shown are illustrative of the desired function only, the Contractor may elect to perform the required functions by other standard logic techniques. Components and circuits used shall be subject to review and approval. All switching circuits shall be checked and verified by testing before shipment.
- D. CONTROL VOLTAGE:
 1. When the control voltage is shown in the schematics, the Contractor shall use the 120-Vac power, as supplied from the power panels supplies under Division 16.

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SECTION 17321

MICROCOMPUTER BASED SCADA SYSTEM

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Provisions: Requirements of Division 1 and Section 17010 form a part of this Section.
- B. Modify existing Supervisory Control And Data Acquisition (SCADA) System, complete all work required, including programming testing, verifying a fully operational system. The System shall include all components shown on the Drawings or specified herein and any additional components required to achieve the intended function. The existing SCADA system is Inductive Automation, Ignition Platform version 7.9.10
 - 1. The Contractor shall retain total responsibility for the proper detailed design, inspection, test, delivery, installation, activation, checkout, adjustment and startup and initial operation of the modified SCADA systems. The Contractor shall be responsible for the delivery of all detailed drawings, manuals and other documentation required for the complete coordination, installation, activation and operation of the system and shall supervise all activities required to place the system in stable operation.

1.02 SUPERVISION

- A. The SCADA System supplier shall furnish an engineer experienced in the installation and operation of the system furnished under this Section for a total time at the site of not less than ten (10) working days to supervise the installation and adjustment of the equipment.
- B. The engineer shall be present at frequent enough intervals to ensure proper adjustment and satisfactory operation of the system; he or she shall be present at least once during each of the following times:
 - 1. Factory Testing
 - 2. Field Testing
 - 3. Final Operational Testing

1.03 ACCESS

- A. The Owner and the Engineer shall have the right of access to the Contractor's facility and the facilities of his equipment suppliers to inspect materials and

parts; to witness inspections, tests and work in progress; and to examine applicable design documents, records and certifications during any stage of design, fabrication, installation, and tests. Office space, supplies, and services required for these surveillance activities shall be furnished by the Contractor and his equipment suppliers.

1.04 SUBMITTALS

- A. The Contractor shall make all submittals as specified herein.
- B. Color Screen print outs of each modified or new screen developed.
 - 1. Include a list of all new alarms created, that will be added to the Alarm List.
- C. Submittal information shall include SCADA programmers resume and summary of work experience.
- D. OPERATION AND MAINTENANCE MANUALS:
 - 1. Manuals shall include a complete description of all operational features of the system including, but not limited to, a thorough discussion of data acquisition, control algorithms, coding, security and transmission, operator/machine interfacing, sample log printouts, typical CRT screen formats, troubleshooting, diagnostic aids and a preventive maintenance schedule.
 - 2. Graphic screen printouts, Alarm tag descriptions, and historian tag names.
 - 3. Following favorable review of this preliminary manual by the Engineer, deliver three revised copies (bound in sets) to the Engineer prior to operation or acceptance of the completed project, whichever occurs first.
- E. Full documentation shall be delivered to the Engineer prior to final acceptance of the work. Standard and specially prepared software documentation shall be amended as required to delineate all modifications and to accurately reflect the final software configuration.
 - 1. Provide the following as a minimum:
 - a. Electronic copies (2) of the as installed program modifications.
 - b. One set of written as-built documentation for all special software provided.

1.05 QUALITY ASSURANCE

- A. Provide all programming, training, installation coordination, startup and warranty services required by the Specifications. Contractor shall employ

programmers and technicians necessary to provide and support a complete system.

- B. The specifications listed below are intended to indicate the minimum requirements of the system but will in no way relieve the Contractor from the responsibility to supply all necessary to accomplish the functional tasks indicated by the total system specifications.

1.06 PRELIMINARY DESIGN REVIEW

- A. Prior to any submission, a review meeting shall be conducted by the Contractor to insure design compatibility with all system requirements. Other supplemental design review meetings may be held as required by the Engineer to resolve specific problems, to provide positive assurance to the Engineer that the design conforms to contractual requirements, or to allow for concurrent planning activities which are dependent upon the as-built system configuration/operation. Design reviews shall, at the discretion of the Engineer, be conducted at the Owner's facility, the Engineer's office, the Contractor's facility, or at a location suggested by the Contractor.
- B. The preliminary design review shall be conducted no later than 30 days after date of Notice to Proceed. Data made available by the Contractor shall include, but not be limited to, the following:
1. Overview of software design and organization, including control system and operating personnel interactions.
 2. Project Schedules for system development, assembly, check-out, installation, activation and factory test activities.
 3. Intended plan for implementing system development, assembly, check-out, installation, activation and factory test activities.
 4. Identification of critical engineering activities and long lead-time procurement items.
 5. Preliminary compilation of suggested system and control strategy design alternatives.
 6. The following software information:
 - a. Overall description of software organization.
 - b. List and description of standard software items including utility and diagnostic routines, mathematical subroutines and operating systems.
 - c. List and description of all standard application programs including, but not limited to, the executive system as tailored; data acquisition; data processing; alarm programs; operator request response programs; and data communication programs.
 - d. A detailed description of how control strategies are implemented and modified.

1.07 FINAL DESIGN REVIEW

- A. No later than 90 days after date of Notice to Proceed, there shall be a formal meeting to finalize all major detail design concepts and plans. The review shall be conducted, and problem areas resolved prior to the release of drawings and the implementation of procurement activities. To the greatest extent possible, all data to be presented at the final design review shall be furnished to the Owner and the Engineer at least two weeks prior to the critical design review date. These data shall include, but not be limited to, the following:
1. Detailed software specifications. Include sketches or video copies of all proposed screens and draft printouts of all reports.
 2. A preliminary factory test plan.
 3. A copy of the proposed training schedule.
 4. A copy of proposed maintenance contract.
 5. Project Schedules.
 6. Results of action items established during the preliminary design review.

1.08 PROGRESS REPORTS

- A. Significant milestones for all key tasks relating to engineering, software development, procurement, fabrication, assembly, test and installation shall be incorporated in the Critical Path Method (CPM) schedule specified in the General Conditions. Submittals and deliverable documentation shall be among the milestones charted. Each monthly progress report specified for the CPM schedule shall show actual performance against projected performance.

1.09 CODES AND STANDARDS

- A. **Codes:** All the Computer System equipment and materials, including their installation, shall conform to the following applicable codes and requirements:
1. National Electrical Code.
 2. National Electrical Safety Code.
 3. Occupational Safety and Health Act standards.
 4. Federal Communications Commission requirements Title 47, Part 90 of the Code of Federal Regulations.
 5. Any applicable local electrical and/or safety codes.
- B. **Variances:** In instances where two codes conflict, the more restrictive requirements shall apply.
- C. **Standards:** Equipment shall conform to the applicable EIA, IEEE, NEMA, and SAMA Standards. The revisions of these standards, in effect on the date of

- issuance of the Contract Documents, shall apply unless a specific edition is referenced.
- D. Underwriters Laboratories listing shall be required for all equipment and materials where such listing is offered by the Underwriters Laboratories.

PART 2 - PRODUCTS

2.01 EXISTING SCADA SOFTWARE MODIFICATIONS

- A. Graphic Display Creation: Provide new screens to enable human machine interface (HMI) to meet the functions set forth in these plans and specifications. Data acquisition, alarm and event notification, report generation, and historical data archive. The screens developed shall be consistent with existing screens and be easy to use.
- B. USER INTERFACE:
1. Graphic Displays: Four types of graphic displays shall be provided: System Graphics, control, trend plots, and bar graph displays. The number of graphic displays that can be setup shall only be limited by hard disk capacity.
 - a. Provide or modify a mouse driven menu so that the operator can page through (linked displays) site displays.
 2. The Contractor shall develop graphic displays or provide sufficient displays to cover all I/O points in the system as part of this contract, in cooperation with the Owner and the Engineer. These displays shall be available for use during startup.

PART 3 - EXECUTION

3.01 JOBSITE TEST

- A. After the SCADA system has passed the Witnessed Factory Test and after it has been installed at the jobsite, a demonstration of compliance with all functional objectives shall be made under actual or simulated operating conditions, subject to favorable review by the Engineer. The Engineer shall witness the test.
- B. Testing activities shall include the simulation of both normal and abnormal operating conditions, including the simulation of failure occurrences. All graphic screens and reports shall be demonstrated as being operational. In addition, each I/O points shall be verified by manually modifying the point in the field and observing the point on the computer system. Substitute analog

data signals may be used to simulate process variables, where such substitutions have been favorably reviewed by the Engineer.

3.02 TRAINING

- A. General: The manufacturer shall provide operator and maintenance training to accomplish the following objectives:
1. To instruct the Owner's personnel in the use of various maintenance procedures and test equipment and procedures available to isolate and correct malfunctions to a circuit board replacement level.
 2. To instruct the Owner's personnel in the operation and philosophy of the specific equipment of this system, with emphasis on the daily operating procedures of the system.
 3. To instruct the Owner's personnel in the organization, development and utilization of the computer system.
 4. The level of training shall be sufficient to familiarize the Owner's personnel with the application of data acquisition programs. All essential system operating procedures shall be described as required to enable personnel to operate the system via the control console and keyboard(s). The training course shall include a minimum of 1-day training time.

END OF SECTION

SECTION 17330

PROGRAMMABLE LOGIC CONTROLLERS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Provisions: Requirements of Division 1 and Section 17010 form a part of this Section.

1.02 SUBMITTALS

- A. The following items shall be submitted in this Section shall be made in one package under the Product Review category of Shop Drawings.

1. Catalog cuts for the central processing unit, input modules, output modules, programmer, magnetic program storage device, interfacing equipment, power line voltage regulation transformer, and power line surge protection device.
2. Heat load data for the power line voltage regulation transformer.
3. A layout drawing of the PLC enclosure.
4. Software documentation to include fully-annotated, line-by-line ladder diagrams. Diagram descriptions must contain Instrument tag number description. For instrument tag number listings, see Appendix A and Section 17010.
5. An Input/Output (I/O) record containing a textual description for each item of input and output, connection diagram addressing (rack, module, channel and address numbers), and data table bit and data table word assignments.
6. A typewritten document containing startup, operation, and maintenance procedures.
7. The Factory and Field Witnessed Test procedure.
8. The Factory and Field Witnessed Test results.
9. Documentation to confirm that the spare memory requirement is complied with.
10. Parts List: Submit a parts list with current net prices and a list of recommended spares.

1.03 QUALITY ASSURANCE

- A. Provide programmable logic controllers (PLCs) which comply with NEMA Standard ICS 3 304. This standard applies to the construction, programming, performance, test, installation, protection, and safety of PLCs.

1.04 UL LABEL

- A. Programmable controller enclosures shall bear the UL label. See Section 17510.

1.05 APPENDICES

- A. Appendix A: This appendix describes the pump controls monitoring and control of the three (3) pumps at the Lipoa Wastewater Pump Station (WWPS).
- B. Appendix B: PLC Input/Output Schedule. This schedule is a complete schedule of all I/O. Additional I/O may be configured as required to implement control strategies by first assigning an instrument tag number, description, function and I/O type. Additional I/O added delineates the spare amount required. The Engineer approves use of all instrument tag numbers.

PART 2 - PRODUCTS

2.01 PROGRAMMABLE LOGIC CONTROLLERS

- A. General: The I&C Subcontractor shall provide programmable logic controller hardware and software as described herein and as shown on the Drawings.
- B. Programmable Logic Controller: Provide PLC with the following hardware.
 1. I/O Chassis: Provide a 7-slot (min) universal I/O chassis to house the processor, power supply and I/O modules. The selection of size slot and number of chassis to achieve a satisfactory complement of I/O modules is the responsibility of the Contractor.
 2. Power Supply: Provide power supply module to power the processor and local I/O modules. I/O back plane loading shall not exceed 75% of power supply rating amps on any chassis.
 3. Memory Enhancement: The processor shall have 3/or.0 MB basic memory. Provide memory enhancement if the program exceeds 75% of capacity.
 4. Cables: Provide a full complement of cables for connecting to programming terminal and interface devices.
 5. Central Processing Unit: The Central Processing Unit (CPU) shall be powered by 24 VDC, and shall have the following:
 - a. PLC "ladder logic" software with extend math functions and online/offline programming functions.
 - b. Local I/O Scanner.
 - c. Floating point arithmetic.
 - d. PID loop control.
 - e. Battery-backed (10-year lithium) CMOS RAM.

- f. The CPU shall be no less than CompactLogix 5380 (5069-L310ERM or better), or equal.
- 6. Power Supply: 24 Vdc, Allen Bradley or equal.
- 7. Input and Output Modules:
 - a. Analog inputs (AI) shall meet the following requirements:
 - 1) Analog inputs (AI) shall meet the following requirements:
 - 2) 4 to 20 mA inputs, 250-ohm impedance maximum, 8 single ended configurations.
 - 3) Accuracy of $\pm 0.15\%$ of span.
 - 4) Resolution: 16 bits
 - 5) Common Mode Rejection of 100 dB at 60 Hz, minimum.
 - 6) Normal Mode Rejection of 80 dB at 60 Hz, minimum.
 - 7) Isolation shall meet or exceed surge-withstand test, IEEE 472.
 - 8) Drift shall not exceed 1.5% within a one-year period @ 25°C
 - 9) Modules shall be Allen-Bradley 5069-IF8 for CompactLogix or equal.
 - b. Discrete inputs (DI) shall meet the following requirements:
 - 1) Unpowered contact inputs or power inputs at 24 Vdc.
 - 2) Input isolation shall meet or exceed IEEE 472. Relay isolation is unacceptable.
 - 3) Provide filtering on a per unit point basis to provide contact bounce protection.
 - 4) Discrete inputs shall be powered by the PLC by a 24-Vdc power supply; shall be current limited to conform to NEC Class 2 remote control and signal wiring circuits.
 - 5) Modules with 16 inputs with common ground terminals. Voltage input modules shall have their channels fully isolated.
 - 6) Modules shall be Allen-Bradley 5069-IA16 for CompactLogix, or equal.
 - c. Analog outputs (AO) shall meet the following requirements.
 - 1) Output: 4 20 mA into a 0 to 500 ohm load; six individually isolated output configurations with separate grounds.
 - 2) Isolation: From the multiplexer ground.
 - 3) Resolution: 13 bits.
 - 4) Accuracy: $\pm 0.1\%$ of 4 to 21 mA
 - 5) Drift: Shall not exceed 1% in a one-year period.
 - 6) Output short circuit protection shall be electronically limited to 21 mA or less with 24 V AC/DC maximum overvoltage protection.
 - 7) Modules shall be Allen-Bradley 5069-OF8 for CompactLogix, or equal.
 - d. Discrete outputs (DO) shall meet the following requirements:
 - 1) Electrically-latched outputs shall require one program command for set and reset. Loss of power shall return the output to a preselected state. Both fail open and fail close contact states shall be provided.

- 2) Contact configuration shall be N.O.; triac outputs - supply with suppression circuit for inductive load.
 - 3) Provide the following ratings: 2A steady state, 15A make at 30 Vdc inductive load for external relays.
 - 4) Provide arc-suppression for each contact.
 - 5) Provide 16 isolated output configuration.
 - 6) Modules shall be Allen-Bradley 5069 for CompactLogix, or equal.
 - e. Provide spare inputs and outputs so that a minimum of 20% of each type is spare, functional, and installed in the mounting racks. Permanently label each input and output on each module by the tag number and description given in the Instrument Schedule.
 - f. Provide at least two spare slots for future modifications/additions.
 - g. Remote I/O Adapter: Provide a remote I/O adapter for communication between the CPU and other I/O chassis, if required.
 - h. Provide blank plates for all unused I/O slots.
 - i. Modules shall be Allen-Bradley 5069-0A16 for CompactLogix, or approved equal.
8. Network Communications: Provide each PLC with Ethernet communications (Ethernet/IP) using TCP/IP protocol.

C. PLC Software: RSLogix 5000 to be used.

D. PROGRAMMABLE LOGIC CONTROLLER ENCLOSURE:

- 1. The PLC hardware shall be furnished completely assembled and wired in electronic rack enclosures (see Section 17510). Provide for serviceable layout of parts. Provide enclosure finish and color to match the motor control center.
- 2. Note that certain selector switches, pushbuttons, relays and instruments shall be furnished and installed in addition to the programmable logic controller hardware proper.

2.02 UNINTERRUPTIBLE POWER SUPPLY (UPS)

A. UPS: Provide a UPS sized 1500VA to provide a minimum runtime of 15 minutes. If additional capacity is required provide additional UPS modules. UPS shall have an input and output power of 120 Vac and shall be mounted within the panel as shown on the Drawings. UPS may rest on the panel bottom but provide removable hardware or straps to secure the module in place. UPS shall be constructed with conformal coating. Utilize plugs and non-GFCI receptacles for connection to powered components. Manufacturer: Falcon Model: SSG1.5KRM-1, CONFORMAL-S, UA88376-SSG-HW, or equal.

1. See Drawings for circuit which automatically switches panel power source from utility power to UPS in the event of a utility power failure.

PART 3 - EXECUTION

3.01 WITNESSED TEST

- A. Prior to shipment of the PLC to the jobsite, perform a Witnessed Test. This test shall demonstrate full compliance of the PLC with contract requirements. The test shall be witnessed by the Engineer and the Owner or his designated representative.
- B. Prepare a detailed written witnessed test procedure to be submitted at least two weeks prior to start of the test. The test procedure shall describe testing methods and provide detailed specification of the input data and data sequences to be used in the test. If, in the opinion of the Engineer, a resubmission of the proposed test procedure is required, the date for the performance of this test shall be set at least six weeks following delivery of the resubmitted test procedure.
- C. Perform the witnessed test in accordance with the test procedure. Any deviation in performance from that specified in these Specifications shall be corrected prior to shipment. If the deviation in performance is deemed by the Engineer to be substantial and if it is not corrected within the period allowed for the test, then a second test shall be performed.
- D. Submit the results of the test in a formal document within two weeks following satisfactory performance of the test. The test results shall document all problems encountered in running the test, corrective action taken, and the detailed results of each phase of the test.

3.02 JOBSITE TEST

- A. After the PLC has been installed at the jobsite, a demonstration of compliance with all functional objectives shall be made under actual or simulated operating conditions, subject to favorable review by the Engineer.
- B. Prepare a detailed written witnessed test procedure to be submitted at least two weeks prior to start of the test. The test procedure shall describe testing methods and provide detailed specification of the input data and data sequences to be used in the test. If, in the opinion of the Engineer, a resubmission of the proposed test procedure is required, the date for the performance of this test shall be set at least six weeks following delivery of the resubmitted test procedure.

- C. Perform the witnessed test in accordance with the test procedure. Any deviation in performance from that specified in these Specifications shall be corrected prior to shipment. If the deviation in performance is deemed by the Engineer to be substantial and if it is not corrected within the period allowed for the test, and then a second test shall be performed.
- D. Submit the results of the test in a formal document within two weeks following satisfactory performance of the test. The test results shall document all problems encountered in running the test, corrective action taken, and the detailed results of each phase of the test.

3.03 TRAINING

- A. General: To familiarize the Owner's personnel with PLC operation, training shall be provided as detailed hereunder. The training course shall be conducted under the direction of a training director who shall design a detailed training plan that complements the experience and skill levels of the Owner's personnel. The training course shall be conducted at the treatment plant. The text for both training courses below shall be the O&M Manual and selected handouts. The Owner may videotape the training at the Owner's expense.
- B. PLC Operations Training: A minimum one-day course shall be provided for up to six persons. The level of training shall be sufficient to familiarize the personnel with the operation of the PLC and programming and program storage device. All essential system operating procedures shall be described as required to enable Owner's personnel to observe the controller operation via the programming device displays.
- C. PLC Corrective Maintenance Training: A one day course shall be conducted for up to six persons on maintenance of modifications to the PLC. Instruction shall be given in the use of hardware diagnostic routines, test equipment and test procedures as required to enable the Owner's personnel to detect and isolate system faults to the circuit board or module level and to implement repairs by replacing failed circuit boards or modules. Step-by-step written procedures shall be provided for identifying hardware faults to the circuit board or module level for all items of digital equipment. All equipment corrective maintenance training activities shall be limited to the use of diagnostic routines with the aid of the programming device. If it is necessary to use special purpose test equipment which is only available from the equipment manufacturer, then such test equipment shall be provided as a part of the system and shall become the property of the Owner.
- D. Additional PLC Training: If requested by Owner, a portion of the field instrument training required in Section 17010 may be allocated toward a continuation of either training course above or covering a specific topic. The

Owner and Contractor must agree to the training content prior to commencing any training.

END OF SECTION

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SECTION 17330A

APPENDIX A PUMP CONTROLS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This appendix describes the monitoring and control of the three (3) pumps at the Lipoa Wastewater Pump Station (WWPS).

1.02 PROCESS OVERVIEW

- A. Raw wastewater flows by gravity into the pump station's wet well. Three submersible pumps (P-100, P-200, and P-300) pump from the wetwell through a 14-inch forcemain and deliver the wastewater to the headworks of the Kihei Wastewater Reclamation Facility.

PART 2 - PRODUCTS

2.01 PROCESS AND INSTRUMENTATION EQUIPMENT

- A. Three (3) submersible pumps equipped with duty and standby variable frequency drives VFD-100 (VFD-1A and 1B), VFD-200 (VFD-2A and 2B), VFD-300 (VFD-3A and 3B)).
- B. Level transmitter (LT-100) that measures the level in the wetwell and controls the pumps.
- C. High water level switch (LSH-101) that will be used as a backup control to start the pumps send an alarm to the plant that the water has exceeded the maximum level set point. This level switch acts as a back up control for pumps.
- D. Manual pressure gauge mounted on a diaphragm seal for each pump discharge and a pressure indicating transmitter on the combined manifold to provide monitoring of pump discharge pressure.
- E. Hand-Off-Auto (HOA) switch (HS-X00A) that allows the operators to set the pumps to run in automatic mode or run the pumps locally at a manually set speed (set at the VFD).

PART 3 - EXECUTION

3.01 PREPARATION

A. SCADA SYSTEM AND PLC STRATEGIES – GENERAL:

1. The Pump Station Control System shall provide:
 - a. Manual Control of the Pump Station either locally or remotely from SCADA.
 - b. Automatic control of the Pump Station, selectable from either SCADA or the local Operator Interface Terminal (HMI).

3.02 INSTALLATION

A. BASIC OPERATING CONTROL STRATEGIES:

1. General: The following “Control Strategy” descriptions define the key features associated with the pump station. These control strategies provide the system integrator with an overview of the operation parameters that will be expected. The system integrator will develop the PLC programs for the PLCs based on the operating strategies described below, and the P&IDs.
2. Motor: Where the P&IDs define that a motor load is controlled by a PLC, all of the status and alarm functions shall be displayed on SCADA. Both a PLC automatic based control strategy and a manual overall control via SCADA shall be provided for each motor. All setpoints shall be accessible and modifiable via SCADA and the local OIT.
3. Pump Station Alarms: Each equipment failure, low-low state, low-state, high-state, high-high state, communication failures, normal power failures, or UPS power failures shall be reportable via SCADA and the local HMI.
4. Pump Station Status and Control: All instrumentation analog values, in actual engineering units shall be accessible from the SCADA and the local HMI.
5. Instrumentation:
 - a. Where the P&IDs define that an instrumentation device is monitored by a PLC, all status and alarm functions shall be displayed on SCADA and the local HMI.
 - b. All instrumentation having an analog value shall have a PLC based High-High, High, Low, and Low-Low alarms (or as indicated on the P&IDs) that can be monitored by SCADA and the local HMI. Each alarm shall have a PLC-based set point that can be adjusted via SCADA and the local HMI. Each alarm shall have a means to be enabled or disabled via SCADA and the local HMI.

- c. All instrumentation having an analog value shall be trended historically and shall be available for staff to rend and perform analysis via the Historian.

B. PROCESS OVERVIEW:

1. The Pump Station will consist of a triplex alternating pump system using three (3) equally sized submersible pumps.
2. All pumps should alternate starts.
3. No more than two pumps will operate at a time.
4. The level transmitter shall start and stop the pumps during normal operations via the local PLC.
5. The high-high level float shall start the pumps should the level transmitter fail or if the PLC becomes disabled. In Automatic Mode, the pumps will start and stop with operator adjustable setpoints. A failure alarm shall be issued if the pump fails, a low flow condition is detected, or the high-high level float is triggered.
6. The PLC shall show flow data including instantaneous, non-resettable total, resettable total, current day, and previous day flows.
7. The pumps may be monitored and controlled locally or remotely through SCADA.

3.03 CONTROL STRATEGY – WASTEWATER PUMP STATION

- A. The pumps may be controlled automatically or manually. Control through the PLC will only occur when the local hand switches are in the Auto mode.
- B. When HS-100A, HS-200A, or HS-300A is in Hand mode, the pump will run with manual control of the pump side via the local speed controller. When HS-100A, HS-200A, or HS-300A is in OFF mode, the pump will not run and is not available for automatic operation, manual operation, or level switch override operation. When HS-100A, HS-200A, or HS-300A is in Auto Mode (for each pump), the pumps will be controlled by the PLC.
- C. SCADA Operation: From SCADA, pump station PLC control can be placed in either Remote Manual Control or Automatic Control. Remote Manual Control: When Remote Manual Mode is selected at SCADA, the pump shall be capable of manual control from SCADA. The pump operations are "Start" and "Stop" and the speed setting is entered via the HMI. Remote Automatic Control: When the Automatic Control Mode is selected at SCADA, the pump operations shall be as described within this control strategy.
- D. When the Hand/Off/Automatic Selector Switch for each Pump is set to the "Automatic" position, a "Ready" indicator (located on the HMI screen) will be activated.

- E. Lead/Lag/Standy status shall be assigned to each pump by the PLC with roles rotated to promote even wear of the pumps.
- F. Pumps can be selected by the operator to run in one of two modes:
 - 1. Constant Speed Mode: Pumps will be started and stopped in accordance with the following list. If the level transmitter fails, the PLC will use operator adjustable timer setpoints to determine how long each pump will run before it is stopped:

Elevation (ft)	Description
23.50	High-High Level Alarm (LSHH-100)
22.00	High Level Alarm (LT-100)
20.75	Lag Pump On (LT-100)
19.50	Lead Pump On (LT-100)
18.70	Lag Pump Off (LT-100)
17.80	Lead Pump Off (LT-100)
17.30	Low Level Alarm (LT-100)
16.80	Low Low-Level Alarm (LT-100)

- 2. Variable Speed Mode: The Operator shall select an elevation setpoint (initially set at 19.50, Operator definable) and the lead pump shall operate (speed up or slow down) to maintain that level in the wet well. In the event that the lead pump is not able to maintain the setpoint elevation (exceeds the setpoint by an Operator defined value (initial value 1.00 ft), then the lag pump shall be called to run. If the level setpoint is then achieved, then the lag pump shall turn off. Lead pump will shut off if the wet well level reaches the lead pump off level or if the lead pump at minimum speed drops the level below the set point. Alarms and other settings are as follows:

3.

Elevation (ft)	Description
23.50	High-High Level Alarm (LSHH-100)
22.00	High Level Alarm (LT-100)
Operator defined (Initial setpoint 20.75)	Lag Pump On (LT-100)
Operator defined (Initial setpoint 19.50)	Lead Pump On (LT-100)
Operator defined (Initial setpoint 18.70)	Lag Pump Off (LT-100)
17.80	Lead Pump Off (LT-100)
17.30	Low Level Alarm (LT-100)
16.80	Low Low-Level Alarm (LT-100)

- G. If a pump fails to start "X" seconds (initially set to 30 seconds) after it was commanded to start or has an active fault condition, it will be automatically replaced in the start/stop sequence by the standby pump.
- H. Provide at SCADA elapsed runtime displays for each pump.
 - 1. Daily
 - 2. Total
- I. Provide a High-High Float Level Alarm level alarms based on the status of the float switch.
- J. Once the lead pump has started if the wet well level reaches the Lag Pump On setpoint the lag pump will start and ramp up to full speed (duration shall be tunable from the LCP, (set point is initially set to 10 seconds). The lead and lag pumps will both run until the level in the wet well reaches the Lag Pump Off setpoint. Once the Lag Pump off setpoint has been reached, the lag pump will ramp down (duration shall be tunable from the LCP, initially set to 10 seconds) but the Lead Pump will continue to run. Once the Lead Pump Off setpoint has been reached, the Lead Pump will ramp down (duration shall be tunable from the LCP, initially set to 10 seconds) and the run command for both pumps will be disabled.
- K. If a pump fails to start X seconds (tunable, initially set to 30 seconds) after it was commanded to start or has an active fault condition, it will be automatically replaced in the start/stop sequence by the standby pump.
- L. While in automatic mode, the PLC shall automatically rotate the three pumps based on runtime to equalize the running time. The cycle shall be initiated after all the pumps are stopped. Upon a loss of power and subsequent return to power, the pump starting cycle sequence shall be automatically initiated.

3.04 ALARMS

- A. Wherever called for on the Drawings, whether a PLC input or PLC generated alarm, provide an operator adjustable time delay of 1 to 10 seconds before an alarm is activated unless indicated otherwise.
- B. PUMP FAILURE TO START:
 1. If the PLC issues a command to start a pump and after an operator adjustable time delay, pump running contact fails to close then a failure to start alarm is enabled.
 2. Remote Reset to Pump VFD, fails to allow pump start.

3. Remote Reset to either Pump High Temperature or Pump Moisture High, fails to allow pump to start.
- C. **Pump VFD Failure:** If the pump failure alarm is from the VFD, then an alarm is enabled.
- D. **Pump High Temperature:** A submersible pump relay will monitor the Pump Windings. If a High Temperature Alarm occurs, the pump start command will be disabled. The PLC will issue a remote alarm reset to attempt to reset the alarm condition. After three attempts, if the alarm condition doesn't clear, then a Pump Fail to Start Alarm is issued. Failure of the remote alarm reset to reset the Pump High Temperature Alarm will require onsite inspection and correction of the pump failure alarm.
- E. **Pump Moisture High:** A submersible pump relay will monitor the Pump Casing for moisture or leakage. If a Moisture High Alarm occurs, the pump will be issued a stop command. The PLC will issue a remote alarm reset to attempt to reset the alarm condition. After three attempts, if the alarm condition doesn't clear, then a Pump Fail to Start Alarm is issued. Failure of the remote alarm reset to reset the Pump High Temperature Alarm will require on-site inspection and correction of the pump failure alarm.

3.05 STATUS

- A. **Pump Running Status:** The PLC shall provide SCADA with the following information:
1. Daily runtime for a 24-hour period.
 2. Total runtime.
 3. Average daily runtime.
 4. Number of pumps starts issued per day.
- B. **LEVEL MEASUREMENT SYSTEM:**
1. Level Transmitter:
 - a. Function: Monitor the level in the Wet Well. This level signal is monitored by the Pump Station PLC. This level signal is used in the automatic PLC based control of the Sewage Pumps and alarms:
 - 1) High-High Level Alarm for Wet Well
 - 2) High Level Alarm for Wet Well
 - 3) Low Level Alarm for Wet Well.
 - 4) Low-Low Level Alarm for Wet Well
 - 5) Start and Stop Automatic Control of Lead, Lag and Standby pumps.
 - b. Level Switch:

- 1) Function: The level switch provides alarm status regarding the wet well level as well as backup hardwired control of the Sewage Pumps in the event of either a failure of the PLC or the level transducer.

C. SEWAGE PUMP STATION DISCHARGE FLOWS:

1. Function: A magnetic flow meter will monitor the discharge flow from the Sewage Pumps. This flow signal is for monitoring purposes only and not involved in the control operations of the Sewage Pumps. This flow signal will provide the following data and alarms that will be available via SCADA.
 - a. Discharge Flow

3.06 MISCELLANEOUS STRATEGIES

- A. The SCADA system shall monitor the various alarm status conditions:
1. UPS power failure
 2. UPS low battery
 3. UPS on Battery
 4. Control Power AC Failure
 5. Building and Wet Well Intrusion.
 6. Communication Monitoring
 - a. Any communication failures between the SCADA computers and the PLC shall be logged as SCADA Alarms. Provide watchdog timers or other pinging logic in control devices to assure that communication failures are detected and alarmed in a timely fashion, regardless of whether the control device itself is functioning.
 7. Generator/ATS smart controllers:
 - a. Utility power good.
 - b. Generator power good
 - c. ATS in utility position.
 - d. Generator fuel level.
 - e. Generator starting status.
 - f. Generator engine temperature.
 - g. Generator exercise status.

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SECTION 17330

APPENDIX B

PLC INPUT-OUTPUT SCHEDULE

I/O Tag	Description	P&ID	Type
ZS-200	DISCONNECT STATUS	I-8	DI
TAH-200	PUMP 2 TEMPERATURE	I-8	DI
EI-200	PUMP 2 RUN	I-8	DI
YA-200A	COMMON FAULT	I-8	DI
YA-200B	MOTOR SEAL FAIL	I-8	DI
YA-200C	VFDA FAIL	I-8	DI
YA-200D	VFDB FAIL	I-8	DI
YC-200	RUN COMMAND	I-8	DO
YI-200B	ON BACK UP CONTROL	I-8	DI
YI-200A	PUMP IN AUTO	I-8	DI
HSC-200	VFD RESET	I-8	DO
SI-200A	VFDA PUMP SPEED INDICATOR	I-8	AI
SC-200A	VFDA PUMP SPEED COMMAND	I-8	AO
SI-200B	VFDB PUMP SPEED INDICATOR	I-8	AI
SC-200B	VFDB PUMP SPEED COMMAND	I-8	AO
UI-210	VFD-210 SIGNALS	I-8	ENET
UI-300	VFD-300 SIGNALS	I-8	ENET
ZS-300	DISCONNECT STATUS	I-8	DI
TAH-300	PUMP 3 TEMPERATURE	I-8	DI
EI-300	PUMP 3 RUN	I-8	DI
YA-300A	COMMON FAULT	I-8	DI
YA-300B	MOTOR SEAL FAIL	I-8	DI
YA-300C	VFDA FAIL	I-8	DI
YA-300D	VFDB FAIL	I-8	DI
YC-300	RUN COMMAND	I-8	DO
YI-300B	ON BACK UP CONTROL	I-8	DI
YI-300A	PUMP IN AUTO	I-8	DI
HSC-300	VFD RESET	I-8	DO
SI-300A	VFDA PUMP SPEED INDICATOR	I-8	AI
SC-300A	VFDA PUMP SPEED COMMAND	I-8	AO
SI-300B	VFDB PUMP SPEED INDICATOR	I-8	AI
SC-300B	VFDB PUMP SPEED COMMAND	I-8	AO
UI-310	VFD-310 SIGNALS	I-8	ENET
PI-400	12" MAIN PRESS	I-8	AI
FI-400	12" MAIN FLOW	I-8	AI

I/O Tag	Description	P&ID	Type
LAH-002	DIESEL FUEL STORAGE TANK LEAK	I-9	DI
LI-001	DIESEL FUEL STORAGE TANK LEVEL	I-9	AI
LAH-003	DIESEL FUEL DAY TANK LEAK	I-9	DI
LI-002	DIESEL FUEL DAY TANK LEVEL	I-9	AI
TAH-101	PANEL HIGH TEMP	I-9	DI
YA-101A	24VDC POWER 1 FAIL	I-9	DI
YA-101B	24VDC POWER 2 FAIL	I-9	DI
YA-101C	120V POWER 1 FAIL	I-9	DI
YA-101D	120V POWER 2 FAIL	I-9	DI
YA-101E	REDUNDANCY MODULE FAIL	I-9	DI
ZAH-100	LCP INTRUSION	I-9	DI
FAL-100	UPS BATTERY LOW	I-9	DI
JAF-100	UPS FAIL	I-9	DI
JI-100	UPS ON BATTERY	I-9	DI
YIP-100	ATS GENERATOR ON UTILITY POWER	I-9	DI
YIG-100	ATS GENERATOR ON GEN POWER	I-9	DI
YIU-100	ATS GENERATOR UTILITY AVAILABLE	I-9	DI
YIR-100	STANDBY GENERATOR RUNNING	I-9	DI
YIA-100	STANDBY GENERATOR IN AUTO	I-9	DI
YIF-100	STANDBY GENERATOR FAIL	I-9	DI
ZAH-101	GENERATOR ROOM INTRUSION	I-9	DI
ZAH-102	ELECTRICAL ROOM INTRUSION	I-9	DI
UI-001	BIOLOGICAL ODOR CONTROL LCP	I-9	ENET
UI-400	PANEL 4MDP POWER MONITOR	I-9	ENET

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SECTION 17425

NETWORK AND COMMUNICATION EQUIPMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Requirements of Division 1 and Section 17010 form a part of this Section. This Section specifies network and communication equipment for Process Control System (PCS) and ancillary data systems to perform the required functions in conjunction with information and equipment specified in other sections of Division 17.
- B. Provide all network and communications identified in the Contract Drawings.

1.02 REFERENCE STANDARDS

- A. Federal Communications Commission (FCC):
 - 1. Title 47, Part 15.5 Low Power (unlicensed) communication devices
- B. Institute of Electrical and Electronics Engineers (IEEE):
 - 1. 802.3 Standard for Ethernet
 - 2. 802.11 Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications
- C. International Organization for Standardization (ISO):
 - 1. 11801 General Cabling for Customer Premises
- D. National Institute of Standards and Technology (NIST)
 - 1. Framework for Improving Critical Infrastructure Cybersecurity
- E. Telecommunications Industry Association (TIA):
 - 1. 568-B Commercial Building Telecommunications Cabling Standard
 - 2. 569-B Commercial Building Standard for Telecommunications Pathways and Spaces
 - 3. 606-A Administration Standard for Commercial Telecommunications Infrastructure
 - 4. J-STD-607-A Commercial Building Grounding and Bonding Requirements for Telecommunications
 - 5. 942 Telecommunications Infrastructure Standard for Data Centers
- F. Underwriters Laboratories Incorporated (UL):
 - 1. 497 Protectors for Paired-Conductor Communications Circuits

1.03 SYSTEM DESCRIPTION

- A. The specification lists requirements for network and communication equipment used in the Process Control System (PCS) and ancillary data systems. This includes electrical cabling based equipment, fiber optic cable based equipment, and wireless (RF) equipment. The electrical cables and fiber cables themselves are specified in Division 16. The Electrical Contractor shall coordinate with the PCS System Integrator for cables to be installed. The PCS System Integrator shall be responsible for all control components and panels and may procure and install all communication equipment.

1.04 SUBMITTALS

- A. Submit a pre-construction Network Topology Diagram showing the planned topology of the control network with sufficient detail such that the Owner could recreate the network. Information shown shall include the following:
1. Network One-Line: a drawing showing the logical topology of the network:
 - a. Show different OSI layer 1 physical media with unique line styles with associated legend.
 - b. TCP/IP Networks: For each node, show its IP address(es), subnet mask, default gateway, and DNS server assignment (if applicable). Denote subnets by network ID.
 - c. Modbus, Profibus, and other master/slave protocols: List all parameter settings used to configure the node's interface to the network such as station ID, transmission speed, etc.
 - d. Identify each node with the ID on the nameplate used in the field. Include a part ID bubble corresponding to a line item in the Bill of Materials, also in this drawing set, to identify the hardware factor of each node.
 2. Layer 2 Switch Configuration:
 - a. Show the physical cable connection being made to each switch port.
 - b. STP settings for each switch port.
 - c. Quality of Services and other traffic shaping settings.
 - d. Management interface login information
 3. Access Control List (ACL): For each control system component on the network, tabulate existing versus new hardware, permitted source and destination IP and/or MAC addresses, permitted versus blocked OSI Layer 4 port numbers, and any other configuration information the Owner would need to replicate the network on new hardware.
 4. Network Site Plan: Submit a set of drawings showing the physical topology of the network. Include dimensioned and directional conduit routing, the locations with ID of all pullboxes, panels, and handholes. Mark the aforementioned and all other network hardware with part ID bubbles corresponding to line items on the Bill of Materials. If this

- information is included on an Electrical Site Plan submittal, then that submittal satisfies the requirements of this clause.
5. Bill of Materials: Include a detailed Bill of Materials. Create a line item for each network component purchased individually including a part ID, description, quantity, manufacturer, and the manufacturer's part number. For PLCs, computers, switches, and other network hardware requiring an operating system and application software, note the versions installed.
 - B. Prepare shop drawings for all network and communication systems, either as part of the PCS submittal or separate submittals for network and communication equipment.
 1. Submit elevation drawings for all communication cabinets and racks including component location, nameplates, dimension and construction information.
 2. Submit a block diagram of the communication and control system detailing the connections between new and existing equipment.
 3. Submit complete bill of materials, with quantity, manufacturer, model number, and recommended spares.
 4. Submit product data for all network and communication components provided.
 - C. Submit complete and signed copies of testing reports which include a description of the testing, detailed test results, and descriptions of issues encountered during testing and any additional action required.
 - D. Record Drawings: Submit record drawings as described in Part 3 of this Section.
 - E. Operations and Maintenance Manual: Provide in accordance with Section 01300.

PART 2 - PRODUCTS

2.01 NETWORKING EQUIPMENT

- A. Ethernet switches
 1. Process control switches managed/unmanaged 10/100 MB baud rate with automatic port sensing.
 2. DIN rail mount.
 3. Operating Temperature: 0 to 60 degree C.
 4. Panel Mount: type MOXA EDS-518A; Allen Bradley Stratix 5700 (Full Cisco IOS); or equal.

2.02 RADIO EQUIPMENT – GENERAL

- A. Radios shall use licensed spectrum operating at 450MHz.

1. Provide radio(s), antenna(s), transmission cables, connectors, surge protection devices, software and other components for a complete wireless communication system.
 2. Data interface: Ethernet RJ45, as appropriate for the control hardware used in the project. Ethernet shall be capable of connecting to TCP/IP based industrial protocols.
 3. Band: 450MHz, licensed,
 4. Data Requirements: Ethernet
 5. Manufacturer: MDS Orbit per County of Maui Radio Survey Report, no equal.
- B. Antenna: Provide (a directional, yagi-style) OR (an omnidirectional, dipole style) antenna suitable for communication in the 450MHz to 470Mhzfrequency range.
1. Construction:
 - a. Antenna shall have an "N" style female connector for cable attachment.
 - b. Nominal impedance: 50 ohms.
 - c. Wind rating: 100 mph minimum.
 - d. Power rating: 150 watts minimum.
 - e. Front-to-back ratio: 15 dB minimum.
 - f. Gain and number of elements shall be determined based on the recommendations of the Radio Path Study.
 - g. Provide all required mounting hardware including brackets, clamps, and associated components for a complete installation.
 2. Manufacturer: Antennex Y4505 per County of Maui Radio Survey Report, no equal.
- B. Lightning Arrester
1. Provide a lightning arrester in the feeder cable between the antenna and radio, bonded to the facility grounding system. Lightning arrester shall be mounted outside of the enclosure containing the radio.
 2. Manufacturer: Polyphaser; Phoenix Contact; Commscope; or approved equal.
- C. Antenna Feeder Cable
1. Provide LMR-400 coaxial antenna feeder cables as shown on the Drawings and called out in the County of Maui Radio Survey Report.
 2. Provide weatherproofing kit for all exposed connectors.

PART 3 - EXECUTION

3.01 CONFIGURATION

3.02 INSTALLATION

A. Ethernet Terminations:

1. Terminate cables at each end into crimp connectors or punch-down terminals as applicable to the equipment being connected. Match the Category rating (per TIA standards) of the crimp connectors, keystone jacks, or patch panels with the rating of the cable being terminated.
 2. Where multiple cables are routed to a single location (such as at a network rack), bundle and route cables in a neat and workmanlike manner to their point of termination. Arrange connections to patch panels in a logical fashion such that adjacent patch panel jacks are connected to adjacent jacks located in the field.
- B. Ethernet Switches:
1. Where rack-mounted, install cable management devices in the space immediately below each switch.
- C. Radio antenna and cable:
1. Install according to radio system integrator's instruction.
 2. Antenna mounting height and aiming shall be as defined in the Radio Path Study.
 3. Provide stainless steel U-bolt and anti-twist saddle bracket to mount antenna to mast.
 4. Securely affix cable to antenna mast using stainless steel clamps or equal. Provide protective rubber to prohibit the clamp from damaging the cable jacket.
 5. Provide waterproof boots and masking for all exterior connections.
 6. Provide a drip loop adjacent to each exterior connection and at the point of transition from exterior to interior.
 7. Ground the antenna cable surge suppressor to the nearest point of the electrical grounding electrode system.

3.03 TESTING

- A. Installed Ethernet cables: Perform testing in accordance with – Electrical Tests.
- B. Radio antenna and cable installations: Perform testing in accordance with the equipment manufacturer's recommendations.

3.04 RECORD DRAWINGS

- A. Prepare and submit a revised Network Topology Diagram to reflect the as-built conditions of the control network. Include any necessary revisions to the information shown in the pre-construction diagram.

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SECTION 17510
PANELS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Provisions: Requirements of Division 1 and Section 17010 form a part of this Section.
- B. Work Included: This Section covers control panels shown on the Electrical or Instrumentation Drawings, or as specified in either Division 16 or 17, and sets minimum standards for all packaged unit panels specified in Divisions 11 to 15, unless modified under those sections.

1.02 REFERENCE STANDARDS

- A. NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA) PUBLICATIONS:
 - 1. ICS 1 General Standards for Industrial Controls and Systems
 - 2. ICS 2 Standards for Industrial Control Devices, Controllers and Assemblies
 - 3. ICS 4 Terminal Blocks for Industrial Control Equipment and Systems
 - 4. ICS 6 Enclosures for Industrial Controls and Systems
- B. UNDERWRITERS LABORATORIES (UL) PUBLICATION:
 - 1. 508 Industrial Control Equipment

1.03 SUBMITTALS

- A. Provide submittals in accordance with Section 01300. Shop drawings to be submitted in this Section shall be made in one package under the Product Review Category of Shop Drawings.
- B. Shop Drawings: Submit shop drawings for all control panels, including details for the following items:
 - 1. Electric power wiring schematics.
 - 2. Electric signal wiring schematics.
 - 3. Elementary control diagram.
 - 4. Fabrication drawings, including a dimensioned outline drawing to scale, showing space for conduits, etc.

5. Seismic design certifications and anchorage descriptions as required by Section 01190.
 6. Details of all panel accessories.
 7. A detailed Bill of Materials.
 8. Panel layouts and nameplate inscriptions.
 9. Connections to external equipment.
 10. Wire marking scheme.
 11. Arrange submissions in a logical manner and on the shop drawings use the device abbreviation identifications and equipment names as shown on the Drawings, in order to expedite and facilitate review by the Engineer.
 12. Where unit arrangement or wiring deviates in any way from that shown on the Drawings, provide a complete record and explanation of such deviations.
- C. **Spare Parts List:** Include a spare parts list showing recommended parts and quantities as well as complete ordering information for replacement components. Provide instruction books for special control devices and special equipment installed in the control panels. Submit these to the Engineer prior to installation of the equipment.
- D. **Manuals:** Provide manuals as specified in Section 17010.

1.04 UL LABEL

A. **UL Label:**

1. Each control panel and terminal cabinet shall bear the UL label except as noted in the following paragraph. The UL label shall apply to the enclosure, the specific equipment supplied with the enclosure, and the installation and wiring of the equipment within and on the enclosure. If required for UL labeling, provide ground fault interrupters, isolation transformers, fuses, and any other necessary equipment, even though such equipment is not indicated on the Drawings. The fabricator shall be an approved UL listed manufacturer.
2. Control panel enclosures containing instruments mounted through the enclosure walls or door shall meet all requirements for UL labeling as above, but no UL label is required. This exception applies only if UL Recognized instruments for the intended purpose are not made.

1.05 PRODUCT DELIVERY AND HANDLING

- A. Ship assembled control panels in sections that facilitate handling and field installation.

PART 2 - PRODUCTS

2.01 CONSTRUCTION

A. GENERAL:

1. Provide panels as shown on the Drawings. Panels shall conform to the requirements of NEMA Standards ICS 1 (General Standards for Industrial Controls and Systems) and ICS 2 (Standards for Industrial Control Devices, Controllers and Assemblies). The panels shall be wall-mounted or freestanding floor mounted, as shown. Provide sufficient access to the panels.
2. The enclosures shall be code gauge steel of adequate strength, when complete, to withstand seismic forces equivalent to those noted in Division 1, General Conditions, Paragraph 1-71. Enclosures shall conform to requirements of NEMA Standard ICS 6 (Enclosures for Industrial Controls and Systems).
3. The enclosures shall have vertically hinged front doors; provide hinge on side of panel that ensures compliance with the 30-inch rule in NEC Paragraph 110-16(a). Freestanding enclosures shall have doors secured by keyed three point latches, except in corrosive locations. Mount the devices through the doors or on recessed plates. Provide nameplates indicated on the Drawings. Each component within the panel shall be securely mounted and arranged for easy servicing, such that all adjustments and component removal can be accomplished without disturbing other components. No fastening devices shall project through the outer surfaces of the cabinet and all components and terminals shall be mounted on mounting pans within the panels.
4. Construction requirements on a specific type of panel are provided in subsequent paragraphs.

B. Safety Requirements: The electrical supply to each control panel shall be arranged to be disconnected by a single switch or circuit breaker, except for necessary foreign circuits. Any live parts within the control panel fed from foreign control or signal circuits shall be covered or arranged to be disconnected by one of the following methods:

1. Enclosed relays, which are automatically de-energized when the main disconnecting switch is opened.
2. Door-operated enclosed disconnect switches.
3. Clearly identified enclosed manually operated disconnect switches, which may be located inside the control panel door, provided the operating handles are isolated or barriered from all open live parts. Each control panel shall be arranged so that adjustments to timing relays or replacement of fuses can be done without exposure to live parts.

- C. **Piping and Wiring:** Factory wire and pipe control panels. Cable all panel wiring by securing to the panel surfaces with plastic cable ties. Permanently identify each wire at each termination by means of a heat-shrink numbered sleeve. Number all electrically common wires the same, and number each electrically different wire uniquely. Provide red wire color for ac wiring, with white neutral and green ground. Provide blue wiring for dc wiring. Wiring shall be 14-gauge, Type MTW or THHN, 600-volt, stranded copper wire. Where wiring crosses hinged surfaces, provide an 18-inch "U" shaped hinge loop of extra flexible wires secured at both ends. Provide ring-type lugs for all panel wiring; spade-type lugs are unacceptable. Use ratchet type crimping tools, which do not release until proper crimp pressure has been applied.
- D. **Terminal Blocks:** Terminal blocks shall be rated 600 volts for signals greater than 30 V and 300 volts for signals less than 30 V and shall conform to requirements of NEMA Standard ICS 4 (Terminal Blocks for Industrial Control Equipment and Systems). The terminal block and terminal lug shall be compatible. Provide disconnecting terminals for any circuit within the control panel, which can be energized when the branch circuit feeding the control panel, if any, is off. Provide terminals for all external (field) connections and provide at least 15% spare terminals. Identify each terminal permanently with the same number as the wire being terminated. Terminals shall be Allen-Bradley 1492 Series; Buchanan; or equal.
- E. **Nameplates:** Provide nameplates as shown on the Drawings, and as specified in Section 17010. A "CAUTION" nameplate shall be attached to the outside of access doors warning of foreign voltages inside the panel (see "Safety Requirements").
- F. **FINISH:**
1. After fabrication all external welds shall be ground smooth. The entire unit shall be thoroughly degreased, then filled and sanded. All metal surfaces shall be given a rust-inhibiting treatment or passivator, then one coat of synthetic primer, followed by two coats of synthetic enamel. The average overall finish shall be at least 3 mils in thickness. All damage to the finish during installation shall be touched up at the jobsite as approved.
 2. Exterior panel color shall complement adjacent panels and shall be approved by the Owner. Sharp angled horizontal front edges of panels shall be protected by brushed and coated stainless steel angled strip with concealed fasteners.
- G. **SIZE AND SUPPORTS:**
1. Panels shall be of sufficient size to adequately enclose all instruments designated as "panel-mounted" plus ample interior clearance to allow for installation, general servicing, and maintenance of the instruments.

- Weight of instruments shall be supported by Unistrut; Famet; Caine; or equal, channel supports. Panel size shall be as indicated on the Drawings.
2. Provide rigid supports for all devices. Supports shall not cause warping or bowing sides or mounting plates.

H. MOUNTING:

1. Attachment methods shall be detailed on panel fabrication drawing submittals. Heavy panels shall be attached by anchor bolts embedded in beams supporting the floor. See the Structural Drawings for location of beams. Seismic restraints shall be installed as specified by the manufacturer.
2. Mounting pans of rigid sheet steel shall be provided for interior components and accessories as required. A steel divider shall separate pneumatic sections from electrical sections. Devices having both electric and pneumatic connections shall be in the pneumatic section and connected to the electric section with waterproof flexible conduit.

I. ARRANGEMENT:

1. The instruments mounted in the panels shall have the nominal size and general arrangement shown. Panel layouts and nameplates shall conform to the approved submittal.
2. Space shall be provided for instruments indicated as furnished by others to be mounted and wired by the control panel manufacturer. These units shall be shipped to the control panel manufacturer in sufficient time for wiring. Coordination of instrument delivery shall be the responsibility of the Contractor. The instruments and controls to be located on each panel are shown on the instrumentation drawings, electrical schematics, and/or in the individual Specification.

J. VENTILATION:

1. Ventilation shall be provided to prevent internal panel temperatures from exceeding 100°F.
2. Louvers shall be provided, when required for cooling, near the bottoms and tops on the rear doors and side of panels. 80-mesh screens shall cover the insides of louvers.
3. Provide a thermostatically controlled fan in each enclosure when louvers cannot dissipate heat adequately or cause sufficient flow to all panel areas. Ventilation fans shall be low acoustic type suitable for control rooms. Provide removable cleanable or disposable dust filter for each remote site enclosure.
4. Provide heaters and circulating fans in all outdoor panels to prevent condensation.

5. Provide air control cooling system for panels requiring less than 1,500 Btu/hr. heat dissipation.
6. Provide air conditioning for panels requiring high heat removal.

K. CABLE ENTRY PLATES:

1. For top entry panels, a gasketed 10-gauge steel cover plate shall be cut that is suitable for the number of conduits. Cable entry plates are not required for bottom, side or back conduit entry unless the Contractor must specifically control the position, size, and location of cutouts.
2. Cable entry plates shall mount to and be fastened along panel stiffeners and framing segments. Tee nut fasteners are preferred.

L. SIGNAL GROUND BUSES:

1. Provide each panel with at least one isolated signal ground bus. Provide a bus 1-inch wide by $\frac{1}{4}$ -inch thick, running from top to bottom. Provide the bus with tapped holes to accommodate ground connections from various devices in the rack. Provide separate ground buses for analog and discrete/digital signals.
 2. Connect all signal shield grounds within the panel to the ground bus(es) with ring-tongue connectors that bolt to the bus(es).
- M. Signal Ground Plate: For rack, multiple enclosure, or bay systems provide a separate $\frac{1}{4}$ -inch-thick isolated copper system ground plate. Mount this plate in a location central to all system components.

- N. Panel Lights and Receptacles: Panels shall be internally lighted by fluorescent lamps, provided with guards and a toggle switch located convenient to each access door. One duplex GFI type receptacle shall be provided in each panel section. The lights and receptacles shall be wired to outgoing terminal blocks for 120 volt, 60 Hertz, single-phase supply.

2.02 PANEL HARDWARE

- A. All doors shall be set flush with three-point vault-type key-locking latches in addition to any required screw clamps. A minimum of two sets of keys supplied. Doors shall be labeled with "AUTHORIZED PERSONNEL ONLY" in 1-inch letters.
- B. Hinges shall be piano type. All hardware and handles shall be stainless steel.
- C. Leveling adjustments on each panel section shall be provided on freestanding panels.
- D. Status lights, selector switches, and pushbuttons shall be as specified in Section 16955.

- E. Provide a copy of the elementary control diagram for the control panel, enclosed in plastic and mounted inside the panel.
- F. Control panels and electronic racks shall be supplied with door-operated switches (for control circuit interlocking) and accessories as required by Sections 17200 and 16955.
- G. Where noted on the Drawings, provide rack-out devices and access plates to make panel access easier and safer. Panel fabricators shall add full extension drawer guides and adjust width of front access plates to assure access to all components and hardware.
- H. Floor stand kits shall not exceed 24 inches in height nor cause the panel to exceed 84 inches in overall height.

2.03 CONTROL PANELS AND ELECTRONIC RACKS

A. GENERAL:

1. Control panels of steel shall be formed of cold-rolled sheet steel of sufficient thickness and with stiffening as required for fabrication, shipping, erection, and service.
 2. Panels shall be fully enclosed, including top, with no visible seams on the front. Panel front construction shall be minimum 3/16-inch stretcher-leveled, cold-rolled steel with stiffeners as necessary to maintain a flatness of $\pm 1/16$ -inch of any 2-foot span and $\pm 1/8$ -inch over any 8-foot span with all equipment installed. All other sections shall be 12-gauge except doors shall be minimum 14-gauge and shall maintain the same specified flatness when closed and latched. When shown on the Drawings, filler panels shall extend to the ceiling.
 3. Cabinets shall be freestanding with adequate internal bracing to support the weight of instruments and wiring. The cabinet design shall be for front access. Doors shall be key locked with a minimum of two sets of keys supplied. Connections to and from the cabinets shall be through conduit through the bottom except when otherwise indicated on the electrical drawings.
 4. Heavy-duty industrial quality racks shall be 19-inch or 24-inch panel. Framing shall be at least 14-gauge cold rolled steel, and continuously welded, rather than spot welded, at the seams of each intersecting joint.
- B. Finish: After fabrication, all external welds shall be ground smooth. The entire unit shall be thoroughly degreased, then filled and sanded. All metal surfaces shall be given a rust-inhibiting treatment or passivator, then one coat of synthetic primer, followed by two coats of synthetic enamel. The average overall finish shall be at least 3 mils in thickness. All damage to the finish during installation shall be touched up at the job site as approved.

- C. Exterior panel color shall complement adjacent panels and shall be approved by the Owner. Sharp angled horizontal front edges of panels shall be protected by brushed and coated stainless steel angled strip with concealed fasteners.

2.04 MANUFACTURER

- A. Manufacturers of the control panels and terminal cabinets enclosure shall be Hoffman Engineering Company; Circle A-W Products Company; Gibbons Metal Products; or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Installation, testing, calibration, validation, startup and instruction shall be in accordance with Section 17010.
- B. Install each control panel level and plumb, and secure by the favorably reviewed seismic mounting method. Doors shall swing freely and close tightly.
- C. Provide a 3-inch-high concrete pad for each field-mounted, freestanding control panel. Provide a 3-1/2-inch-high I-beam kick panel for each control-room mounted, freestanding panel.
- D. Carefully repair any damage to the structure, components or finish to the satisfaction of the Engineer. Clean all nameplates.
- E. Exercise care at all times after installation of control panels to keep out foreign matter, dust, dirt, debris, or moisture. Use protective sheet metal covers, canvas, heat lamps, etc., as needed to ensure equipment protection.
- F. For all metal panels mounted on concrete walls or floors, install 1/8-inch shims, and paint the back sides and bottom of the panels with Mobil Hi-Build Bituminous Coating 35-J-10; Koppers Bitumastic Super Tank Solution; or equal. Film thickness shall be 10-mil minimum.

END OF SECTION