

State of Hawaii  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
ENGINEERING DIVISION  
Honolulu, Hawaii

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BOARD OF LAND AND NATURAL RESOURCES

Dawn N.S. Chang  
Chairperson

CONTRACT SPECIFICATIONS AND PLANS

Job No. G25CH17A  
UPOLU WELL DEVELOPMENT  
0.5 MG RESERVOIR AND TRANSMISSION MAIN  
North Kohala, Hawaii Island, Hawaii

Design Team

Prime Consultant &

Civil Engineer: Akinaka & Associates, Ltd.

Civil Engineer: SEY Engineers, Inc.

Structural Engineer: Kai Hawaii, Inc.

Geotechnical Engineer: Hirata & Associates, Inc.

Electrical Engineer: Ron N.S. Ho & Associates, Inc.

Surveyors: Island Survey, Inc.


January 2023


State of Hawaii  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
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Honolulu, Hawaii

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Job No. G25CH17A  
UPOLU WELL DEVELOPMENT  
0.5 MG RESERVOIR AND TRANSMISSION MAIN  
North Kohala, Hawaii Island, Hawaii

Approved:   
BRIAN K. KAU, P.E.  
Administrator  
Agricultural Resource Management Division  
Department of Agriculture

Approved:   
CARTY S. CHANG, P.E.  
Chief Engineer  
Engineering Division

January 2023

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DEPARTMENT OF LAND AND NATURAL RESOURCES INTERIM GENERAL  
CONDITIONS, DATED OCTOBER 1994 (Bound Separately)

NOTICE TO BIDDERS  
(Chapter 103D, HRS)

COMPETITIVE BIDS for Job No. G25CH17A, Upolu Well Development, 0.5 MG Reservoir and Transmission Main, North Kohala, Hawaii Island, Hawaii shall be submitted to the Department of Land and Natural Resources, Engineering Division on the specified date and time through the Hawaii State e-Procurement (HlePRO). HlePRO is accessible through the State Procurement Office website at [www.spo.hawaii.gov](http://www.spo.hawaii.gov).

The Department of Land and Natural Resources Interim General Condition, dated October 1994, as amended, and the General Conditions – AG008, latest revision shall be made part of the specifications.

The project is located off the Upolu Airport Road in North Kohala, on the island of Hawaii, TMK (3) 5-5-006:002.

The work shall generally consist of installing a new pump and piping for the existing Upolu Well, construct a new 0.5 MG water storage tank, install influent and effluent watermain, construct an access road, and install perimeter fencing.

To be eligible to submit a bid, the Bidder must possess a valid State of Hawaii Contractor's license classification "A".

A voluntary pre-bid conference will be held virtually through Microsoft Teams on January 26, 2023 at 10.00 A.M. Contact Brandon Kim via email at [brandon.j.kim@hawaii.gov](mailto:brandon.j.kim@hawaii.gov) at least one day prior to obtain a meeting invite for the pre-bid conference.

The estimated cost of construction is \$4,500,000.

The award of the contract, if it be awarded, will be subject to the availability of funds.

Since the estimated cost of construction is \$250,000 or more, the apprenticeship agreement preference pursuant to Hawaii Revised Statutes §103-55.6 (ACT 17, SLH 2009) shall apply.

Should there be any questions, please refer to the HlePRO solicitation.

# INFORMATION AND INSTRUCTIONS TO BIDDERS

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## INFORMATION AND INSTRUCTIONS TO BIDDERS

- A. PROJECT LOCATION AND SCOPE OF WORK: The project location and scope of work shall be as generally described in the Notice to Bidders.
- B. PROPOSALS: Bidders shall submit their bid, including the completed proposal form, bid bond, and any other documents required by the solicitation as part of their bid through the State of Hawaii e-Procurement System (HiePRO). See Item D, PROPOSAL FORM.
- C. GENERAL CONDITIONS: The Department of Land and Natural Resources Interim General Conditions dated October 1994, as amended, shall be made a part of these contract specifications and are referred to hereafter as the General Conditions.
- D. PROPOSAL FORM: **The Bidders shall fill out and upload the electronic copy of the proposal form to the HiePRO website when submitting the bid. Bid Proposals shall not be mailed, faxed or delivered to the State, unless requested to do so after the designated closing date. The successful Bidder shall fill out and print a hard copy of the proposal form, sign and submit the form with the contract award package.**
- E. OMISSIONS OR ERASURES: Any proposal which contains any omission or erasure or alteration not properly initialed, or conditional bid, or other irregularity may be rejected by the Board of Land and Natural Resources (Board).
- F. NOTICE OF INTENT TO BID AND QUESTIONNAIRE:  
A Notice of Intent to Bid is not required for this project. In compliance with HRS Section 103D-310, the lowest responsive and responsible bidder may be required to complete a questionnaire. When requested by the State, the completed questionnaire shall be submitted to the Chief Engineer for evaluation. Failure to furnish the requested information within the time allowed may be grounds for a determination of non-responsibility, in accordance with HRS Section 103D-310 and HAR Section 3-122-108.
- G. BID SECURITY: A bid security will be furnished by each bidder as provided in sub-section 2.7 of the General Conditions. The successful bidder's bid security will be retained until Contract execution and furnished a performance and payment bond in an amount equal to one hundred percent (100%) of the total Contract price, including an amount estimated to be required for extra work, is furnished.
- The Board reserves the right to hold the bid securities of the four lowest bidders until the successful bidder has entered into a contract and has furnished the required performance bond. All bid securities will be returned in accordance with sub-section 3.5 of the General Conditions.
- Should the successful bidder fail to enter into a contract and furnish a satisfactory performance bond within the time stated in the proposal, the bid security shall be forfeited as required by law.
- H. CONTRACTOR'S LICENSE REQUIRED: The Board will reject all bids received from contractors who have not been licensed by the State Contractors License Board in accordance

with Chapter 444, HRS; Title 16, Chapter 77, Hawaii Administrative Rules; and statutes amendatory thereto.

- I. IRREGULAR BIDS: No irregular bids or propositions for doing the work will be considered by the Board.
- J. WITHDRAWAL OF BIDS: No bidder may withdraw his bid between the time of the opening thereof and the award of contract.
- K. SUCCESSFUL BIDDER TO FILE PERFORMANCE AND PAYMENT BONDS: The successful bidder will be required to file performance and payment bonds each; in the amount equal to the total contract price, including amounts estimated to be required for extra work, as provided in sub-section 3.6 of the General Conditions.
- L. NUMBER OF EXECUTED ORIGINAL COUNTERPARTS OF CONTRACT DOCUMENTS: If requested by the Board, six copies of the Contract, performance and payment bonds shall be executed.
- M. CHANGE ORDERS: No work of any kind in connection with the work covered by the plans and specifications shall be considered as change order work, or entitle the Contractor to extra compensation, except when the work has been ordered in writing by the Chief Engineer (Engineer) and in accordance with sub-section 4.2 of the General Conditions.

The Contractor shall clearly identify and inform the Engineer in writing of any deviations from the contract documents at the time of submission and shall obtain the Engineer's written approval to the specified deviation prior to proceeding with any work.

- N. WAGES AND HOURS: In accordance with sub-sections 7.3 to 7.9 of the General Conditions relative to hours of labor, minimum wages and overtime pay, the current minimum wage rates promulgated by the Department of Labor and Industrial Relations (DLIR) shall be paid to the various classes of laborers and mechanics engaged in the performance of this contract on the job site. The minimum wages shall be 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 DLIR.

The Department of Land and Natural Resources will not recognize any claim for additional compensation because of the payment by the Contractor of any wage rate in excess of the said minimum wage rates. The possibility of wage increase is one of the elements to be considered by the Contractor in determining his bid, and will not, under any circumstances, be considered as the basis of a claim against the Department under this Contract.

No work shall be done on Saturdays, Sundays, legal State holidays, and/or in excess of eight (8) hours each day without the written consent of the Engineer. Should permission be granted to work at such times, the Contractor shall pay for all inspection administrative costs thereof. No work shall be done at night unless authorized by the Engineer.

- O. PERMITS: The State will process permit applications whenever possible, and the Contractor shall procure the pre-processed permits and pay the required fees. If permit applications are not processed by the State, the Contractor shall process the permit applications, permits and

licenses, and pay all charges and fees. In all cases, the Contractor shall give all notices necessary and incident to the due and lawful prosecution of the work.

- P. PROPERTY DAMAGE: It shall be the responsibility of the contractor to respect State property and to prevent damage to existing improvements. The Contractor will be responsible for damages resulting from construction operations. Immediately upon discovery, the Contractor shall repair such damage to the satisfaction of the Engineer.

All trees and shrubbery outside the excavation, embankment or construction limits shall be fully protected from injury.

- Q. TIME: The time of completion is specified in the Proposal. It is the Board's intention to insist the Contractor diligently prosecute the work to completion within the specified time.

Prospective bidders are reminded that the State has the option to proceed with or abandon a project depending on whether the project can be completed for occupancy in the specified time.

It is the bidder's responsibility to check the availability of all materials before bidding. The bidder shall select sub-contractors and suppliers who can warrant availability and delivery of all specified or qualified materials to assure project completion within the specified time.

The successful bidder must assume all risks for completing the project by the specified date. There shall be no extension of time for any reason except for delays caused by acts of God, labor disputes involving unions, or actions of the State. If for any reason the project falls behind schedule, the Contractor shall at its own cost, take necessary remedial measures to get the project back on schedule, i.e., working overtime, air freighting all materials, etc. In addition, if the Contractor fails to fully complete the project by the completion date, Contractor will be required to make the facility usable at its own cost.

- R. BIDDER'S RESPONSIBILITY TO PROVIDE PROPER SUPERINTENDENCE: The successful low bidder shall designate in writing to the Engineer the name of its authorized superintendent (Superintendent), who will be present at the job site whenever any work is in progress. The Superintendent shall be responsible for all work, receiving and implementing instructions from the Engineer in a timely manner. The cost for superintendence shall be considered incidental to the project.

If the Superintendent is not present at the site of work, the Engineer shall have the right to suspend the work as described under sub-section 5.5 c. and 7.20 - Suspension of Work of the General Conditions.

- S. LIQUIDATED DAMAGES: Liquidated damages in the amount specified in the Proposal will be assessed for each and every calendar day from and after the expiration of the time period stated in the Contract for the completion of the project.

- T. HIRING OF HAWAII RESIDENTS: The Contractor shall comply with Act 68, SLH 2010, in the performance and for the duration of this contract. The Contractor shall ensure that Hawaii residents compose not less than eighty percent of the workforce employed to perform the contract work on the project. The eighty percent requirement shall be determined by



dividing the total number of hours worked on the contract by Hawaii residents, by the total number of hours worked on the contract by all employees of the Contractor in the performance of the contract. The hours worked by any Subcontractor of the Contractor shall count towards the calculation for this section. The hours worked by employees with shortage trades, as determined by the Department of Labor and Industrial Relations (DLIR), shall not be included in the calculation for this section.

The requirements shall apply to any subcontract of \$50,000 or more in connection with the Contractor, that is, such Subcontractors must also ensure that Hawaii residents compose not less than eighty percent of the Subcontractor's workforce used to perform the subcontract.

- U. WATER AND ELECTRICITY: The Contractor shall make all necessary arrangements and pay all expenses for water and electricity used in the construction of this project.
- V. PUBLIC CONVENIENCE AND SAFETY: The Contractor shall conduct construction operations with due regard to the convenience and safety of the public at all times. No materials or equipment shall be stored where it will interfere with the safe passage of public traffic. The Contractor shall provide, install, and maintain in satisfactory condition, all necessary signs, flares and other protective facilities and shall take all necessary precautions for the protection of the work and the convenience and safety of the public. The Engineer shall have the right to suspend the performance of the work in accordance with sub-section 7.20 - Suspension of Work of the General Conditions.
- W. WORK TO BE DONE WITHOUT DIRECT PAYMENT: Whenever the contract that the Contractor is to perform work or furnish materials of any kind for which no price is fixed in the contract, it shall be understood that the Contractor shall perform such work or furnish said materials without extra charge or allowance or direct payment of any sort. The cost of performing such work or furnishing said material is to be included by the Contractor in a unit price for the appropriate item unless it is expressly specified that such work or material is to be paid for as extra work.
- X. AS-BUILT DRAWINGS: As-built drawings, the intent of which is to record the actual in-place construction so that any future renovations or tie-ins can be anticipated accurately, shall be required. All authorizations given by the Engineer to deviate from the plans shall be drawn on the job site plans. All deviations from alignments, elevations and dimensions which are stipulated on the plans shall be recorded on the as-built drawings. Final as-built drawings shall be submitted to the Engineer for review and approval. After the Engineer approves the as-built drawings, the contractor shall submit an electronic copy in Adobe PDF format on CD ROM.
- Y. ASBESTOS CONTAINING MATERIALS: The use of asbestos containing materials or equipment is prohibited. The Contractor shall insure that all materials and equipment incorporated in the project are asbestos-free
- Z. WORKER SAFETY: The Contractor shall provide, install and maintain in satisfactory condition all necessary protective facilities and shall take all necessary precautions for the protection and safety of its workers in accordance with the Occupational Safety and Health Standards for the State of Hawaii. The Engineer shall have the right to suspend the performance of the work in accordance with sub-section 7.20 - Suspension of Work of the

General Conditions.

- AA. TOILET FACILITIES: All toilet facilities constructed at the project site shall be in accordance with the Public Health Regulations of the State Department of Health (DOH). All necessary precautions shall be observed at the project site. The use of sanitary facilities shall be strictly enforced and workers violating these provisions shall be promptly discharged.
- BB. SIGNS: Whenever the project involves closing or obstructing any public thoroughfare, the Contractor shall provide traffic signs conforming to the applicable provisions of the current edition of the "Manual on Uniform Traffic Control Devices for Streets and Highways", published by the Federal Highway Administration as directed by the Engineer for the purpose of diverting or warning traffic prior to the construction area. All traffic signs shall bear proper wording stating thereon the necessary information as to diverting or warning traffic.

When indicated in the Proposal, the Contractor shall provide a project sign, size 4'-0" x 7'-0" to be placed as directed by the Engineer. The sign shall be constructed in accordance with Section 01581 - Project Sign of these specifications and approved by the Engineer. All wording, type and size of lettering and color selection shall be as specified in these specifications or as approved by the Engineer.

All signs shall be kept neat and clean, and properly erected at all times.

- CC. FIELD OFFICE AREA FOR DEPARTMENT: When indicated in the Proposal, the Contractor shall provide a housed working area of at least 100 square feet adjacent to the Contractor's office for the Department's use. This area will be used by the Engineer to perform tests and to store equipment. As a minimum, the field office shall include the following: standard sized office desk and chair, lighting, ventilation, window-type air conditioning rated at 5,000 BTU, door and window with locking hardware, electrical outlets, and working communications facilities (a cellular telephone is acceptable). The Department will pay for all long distance toll charges made by the Engineer.
- DD. QUANTITIES: All bids will be compared on the basis of quantities of work to be done as shown in the Proposal; the quantities shown in the Unit Price items are estimated, being given as a basis for comparison of bids. The Board reserves the right to increase or decrease the quantities given under the items or delete items entirely as may be required during the progress of the work.
- EE. OTHER HEALTH MEASURES: Forms of work site exposure or conditions which may be detrimental to the health or welfare of workers or of the general public shall be eliminated or reduced to safe levels as required by the DOH codes, standards, and regulations. Suitable first aid kits and a person qualified to render first aid, as specified in the DOH regulations, shall be provided at all times when work is scheduled.
- FF. HAWAII BUSINESS OR COMPLIANT NON-HAWAII BUSINESS REQUIREMENT: Bidders (Contractors) shall be incorporated or organized under the laws of the State or be registered to do business in the State as a separate branch or division that is capable of fully performing under the contract, as stipulated in §3-122-112 HAR.

GG. COMPLIANCE WITH §3-122-112 HAR:

As a condition for award of the contract and as proof of compliance with the requirements of 103D-310(c) HRS, the apparent low bidder shall furnish the required documents to the Department. If the valid required certificates are not submitted on a timely basis for award of a contract, a bidder otherwise responsive and responsible may not receive the award. Bidder is responsible to apply for and submit the following documents to the Department.

- A. TAX CLEARANCE REQUIREMENTS (HRS Chapter 237): Bidder shall obtain a tax clearance certificate from the Hawaii State Department of Taxation (DOTAX) and the Internal Revenue Service (IRS). The certificate is valid for six months from the most recently approved stamp date on the certificate; the certificate must be valid on the date received by the Department.
- B. Department of Labor (DLIR) “**Certificate of Compliance**”. (HRS Chapter 383 - Unemployment Insurance, Chapter 386 - Workers’ Compensation, Chapter 392 - Temporary Disability Insurance, and 393 – Prepaid Health Care): Bidder shall obtain a certificate of compliance from the Hawaii State Department of Labor and Industrial relations (DLIR). The certificate is valid for six months from the date of issue; certificates must be valid on the date received by the Department.
- C. Department of Commerce and Consumer Affairs (DCCA), Business Registration Division (BREG) “**Certificate of Good Standing**”. Bidder shall obtain a certificate of good standing issued by the Department of Commerce and Consumer Affairs (DCCA), Business Registration Division (BREG). The certificate of good standing is valid for six months from the date of issue; certificates must be valid on the date received by the Department.

Alternately, instead of separately applying for these certificates at the various state agencies, bidder may choose to use the Hawaii Compliance Express (HCE), which allows businesses to register online through a simple wizard interface at <http://vendors.chawaii.gov> to acquire a “Certificate of Vendor Compliance” indicating the bidder’s status is compliant with the requirements of §103D-310(c), HRS, and shall be accepted for contracting and final payment purposes. Bidders that elect to use the new HCE services will be required to pay an annual fee of \$12.00 to the Hawaii Information Consortium, LLC (HIC). Bidders choosing not to participate in the HCE program will be required to provide the paper certificates as instructed in the previous paragraphs.

P R O P O S A L

FOR

DEPARTMENT OF LAND AND NATURAL RESOURCES  
ENGINEERING DIVISION  
State of Hawaii

JOB NO. G25CH17A  
UPOLU WELL DEVELOPMENT  
0.5 MG RESERVOIR AND TRANSMISSION MAIN  
North Kohala, Island of Hawaii, Hawaii

\_\_\_\_\_, 2023

Chief Engineer  
Engineering Division  
Department of Land and Natural Resources  
State of Hawaii  
Honolulu, Hawaii

Dear Sir:

The undersigned, having carefully examined the local conditions and all available records and information covering conditions which may affect the cost of the work to be performed, and having carefully examined the Plans and Specifications, and other contract documents, hereby proposes to furnish and pay for all materials, tools, equipment, labor and other incidental work necessary to install a new pump and piping for the existing Upolu Well, construct a new 0.5 MG water storage tank, install influent and effluent watermains, construct an access road and install perimeter fencing, as required or called for in this Proposal, all according to the true intent and meaning of the Notice to Bidders, Information and Instructions to Bidders, Proposal, Detailed Specifications, Interim General Conditions, Plans, and any and all addenda for:

JOB NO. G25CH17A  
UPOLU WELL DEVELOPMENT  
0.5 MG RESERVOIR AND TRANSMISSION MAIN  
North Kohala, Island of Hawaii, Hawaii

on file in the office of the Engineering Division for the TOTAL BASE BID (Items 1 to 93) of:

\_\_\_\_\_  
\_\_\_\_\_  
Dollars (\$ \_\_\_\_\_)  
and will fully complete all work under this contract within 356 consecutive calendar days from the date of written notice to proceed, including date of said order, said total sum being itemized on the following pages.

**JOB NO. G25CH17A**  
**UPOLU WELL DEVELOPMENT, 0.5 MG RESERVOIR, AND TRANSMISSION LINE**  
**North Kohala, Island of Hawaii, Hawaii**  
**BASE BID**

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	TOTAL
<b><u>GENERAL</u></b>					
1	L.S.		NPDES Permit Compliance. For Contractor specific data such as contractor information and project contcts, site specific BMP's and Notice of Intent, etc., for construction phase.		
2	L.S.		Site BMP measures for water pollution and erosion and sediment control during construction phase of project, including installation, maintenance, and removal at end of project		
3	L.S.		Preparation, maintenance and updating of As-Built/Record Drawings for duration of project and final submittal and contractor certification of drawings to Department of Land and Natural Resources at end of project.		
<b>Subtotal for GENERAL (Items 1 to 3)</b>					
<b><u>EARTHWORK, ROADWAY, AND SITE WORK</u></b>					
4	L.S.		Clearing and grubbing		
5	L.S.		Mass site, roadway excavation and embankment inclusive of removal and disposal of excess material to the elevations shown on plan Excavation = 2,590 Cu. Yd. Embankment = 205 Cu. Yd.		
6	49	S.Y.	4" gravel fill over geotextile fabric, grade A #3 course, conforming to ASTM size 5, inclusive of compaction, in place complete		
7	1,645	S.Y.	2" thick asphaltic concrete pavement (Mix No. 3) inclusive of surface preperation, in place complete		
8	1,645	S.Y.	6" thick base course for A.C. Pavement inclusive of compaction, in place complete		
9	1,522	L.F.	6' High chain link fence and appurtenances, including "No Trespassing" signs (5) in place complete		

**JOB NO. G25CH17A**  
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**North Kohala, Island of Hawaii, Hawaii**  
**BASE BID**

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	TOTAL
10	2	EA	6' High double-swing gate and appurtenances, including "No Trespassing" sign in place complete		
11	542	L.F.	Demolish and remove existing cattle fence		
12	2	EA	"Non-Potable Water Do Not Drink" sign and post, in place complete.		
13	7	EA	Pipe Barrier, including excavation, concrete footing, and all related work, in place complete		
14	L.S.		Furnish and install 8-inch well drain line outlet, including excavation, headwall, apron, cutoff wall, wing walls, backfill and related work, in place complete.		
15	37	S.Y.	Rock rip rap, including excavation, mortar, cut-off walls, weep holes, geotextile fabric, backfill and all related work, in place complete.		
16	350	L.F.	4' wide reinforced concrete swale inclusive of excavation and incidental work		
17	94	L.F.	8" cement-lined ductile iron pipe, Cl. 52 (Washout & Overflow Lines), including trench excavation, backfill and cushion material and connection to seepage pits		
18	1	EA	8" Gate valve and valve box (for Tank Washout Line), in place complete		
19	1	EA	8" Tideflex check valve (for Tank Washout Line), in place complete		
20	1	EA	6" Tideflex check valve (for Well Drain Line), in place complete		

**JOB NO. G25CH17A**  
**UPOLU WELL DEVELOPMENT, 0.5 MG RESERVOIR, AND TRANSMISSION LINE**  
**North Kohala, Island of Hawaii, Hawaii**  
**BASE BID**

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	TOTAL
21	L.S.		Perforated Pipe Ring Drain, including but not limited to the following: 267 L.F. 6" HDPE perforated pipe 1 - 6" ABS Tee 2 - COTG 1 - 6" Flap Valve, or S.S. Screen and necessary fittings and accessories, inclusive of excavation aggregate backfill, filter fabric, connections to seepage pits, and necessary related work, in place complete		
22	1	EA	Seepage pit, including but not limited to: excavation, backfill, grating, geotextile fabric, reinforced concrete cover with galvanized metal grate and seat, 8'-0" diameter reinforced concrete ring liners, and all appurtenances and incidental work, in place complete		
23	L.S.		20' wide gravel driveway for access pasture area, inclusive of excavation, backfill, tie-in of existing cattle fence, in place complete		
<b>Subtotal for EARTHWORK, ROADWAY AND SITE WORK (Items 4 to 23)</b>					
<b><u>WATER SYSTEM PIPING AND APPURTENANCES</u></b>					
24	L.S.		Furnish and install one pumping unit including pump, motor, pump piping, valves, wellhead, well column and tubing, instrumentation, testing, painting and appurtenances, in accordance with the plans and specifications, in place complete.		
25	L.S.		Furnish and install new compressed air system (well level) and discharge pressure system, gauge board indicators and gauges, transmitter, tubing, valves, fittings, accessories, testing, painting and appurtenances, in accordance with the plans and specifications, in place complete.		
26	L.S.		Furnish and install underground copper air line in PVC conduit from well to gauge board, including trenching and appurtenances, in accordance with the plans and specifications, in place complete.		

**JOB NO. G25CH17A**  
**UPOLU WELL DEVELOPMENT, 0.5 MG RESERVOIR, AND TRANSMISSION LINE**  
**North Kohala, Island of Hawaii, Hawaii**  
**BASE BID**

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	TOTAL
27	L.S.		Furnish and install flow meter system including gauge board indicator and gauge, tubing, valves, fittings, accessories, testing, painting and appurtenances, in accordance with the plans and specifications, in place complete.		
28	L.S.		Furnish and install Stilling Well with float switch and pressure transducer, and necessary appurtenances, in place complete.		
29	393	L.F.	8" HDPE WL-A pipe and fittings, including trench excavation, pipe cushion, backfill, in place complete		
30	2	L.F.	8"x8"x8" Tee, Butt Fusion		
31	4	L.F.	8" Gate Valve & Box, in place complete		
32	1	EA	8" 1/8 Bend, Butt Fusion		
33	1	EA	8"x6" Reducer, Butt Fusion		
34	1246	L.F.	6" HDPE WL-B pipe and fittings, including trench excavation, pipe cushion, backfill, in place complete		
35	541	L.F.	6" HDPE WL-C pipe and fittings, including trench excavation, pipe cushion, backfill, in place complete		
36	4	EA	8" Gate Valve & Box, in place complete		
37	2	EA	6" Gate Valve Cover and Cap, in place complete		
38	1	EA	1" Air Relief Valve Unit and Box, in place Complete		
39	1.1	C.Y.	CY, DWS 2,500 concrete for reaction blocks, test blocks, concrete beams, slabs, inclusive of necessary structural struts, straps, rods, reinforcing steel and appurtenances, with Geotextile Fabric for abrasion resistance, in place complete.		



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**UPOLU WELL DEVELOPMENT, 0.5 MG RESERVOIR, AND TRANSMISSION LINE**  
**North Kohala, Island of Hawaii, Hawaii**  
**BASE BID**

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	TOTAL
40	L.S.		Contingency for WL-B and WL-C additional bends, fittings, and appertenances, as necessary		\$ 20,000.00
<b>Subtotal for WATER SYSTEM PIPING AND APPURTENANCES (Items 24 to 40)</b>					
<b><u>ELECTRICAL WORK</u></b>					
41	600	L.F.	Trenching & backfill		
42	250	L.F.	4"C, PVC Schedule 40		
43	100	L.F.	3"C, PVC Schedule 40		
44	150	L.F.	2"C, PVC Schedule 40		
45	80	L.F.	1.5"C, PVC Schedule 40		
46	1000	L.F.	1"C, PVC Schedule 40		
47	800	L.F.	Electrical conductor 300KCMIL, RHW		
48	200	L.F.	Electrical conductor #4/0, RHW		
49	2000	L.F.	Electrical conductor #12, RHW		
50	1	EA	Switchboard		
51	1	EA	Switchboard enclosure		
52	1	EA	Motor control center		
53	1	EA	Motor control center enclosure		
54	1	EA	3P400A enclosed circuit breaker, NEMA 3R		
55	3	EA	8"L X 6"W X 6"D junction box, NEMA4XSS		
56	1	EA	Handhole		
57	20	C.Y.	Concrete		
58	1	EA	Service receptacle, weather proof		
59	9	EA	Equipment connection		

**JOB NO. G25CH17A**  
**UPOLU WELL DEVELOPMENT, 0.5 MG RESERVOIR, AND TRANSMISSION LINE**  
**North Kohala, Island of Hawaii, Hawaii**  
**BASE BID**

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	TOTAL
60	1	EA	SCADA system		
61	1	EA	Miscellaneous and testing		
<b>Subtotal for ELECTRICAL WORK (Items 41 to 61)</b>					
<b><u>CONVENTIONALLY REINFORCED CONCRETE RESERVOIR</u></b>					
62	100	C.Y.	Floor Slab- 6" Thick Aggregate Base		
63	5410	S.F.	Floor Slab- 30 mil PVC & 6 mil Poly Sheeting		
64	72	C.Y.	Floor Slab- 6" Reinforced Concrete Slab		
65	60	L.F.	Pipe Jackets-Ef/Influent, Washout, Overflow Pipes		
66	160	L.F.	Floor Slab- Waterstop @ Slab Joint		
67	240	L.F.	Floor Slab- Wall Base Joint		
68	L.S.		Foundation - Probe and Grout		
69	83	C.Y.	Foundation - Wall Footing		
70	34	C.Y.	Foundation - Column Pad Footing		
71	60	EA	Foundation - Seismic Cables		
72	238	C.Y.	Walls - 14" Reinforced Concrete Walls		
73	17	C.Y.	Columns - 18" Diameter Columns		
74	120	EA	Walls - Roof Dowels to Wall		
75	240	L.F.	Walls - Horiz. Wall Joint		
76	L.S.		Walls - Overflow Pipe Coating & Supports		
77	5500	S.F.	Walls - Exterior Painting		
78	136	C.Y.	Roof - 9" Reinforced Concrete Roof Slab		
79	15	C.Y.	Roof - Column Drop Panels		

**JOB NO. G25CH17A**  
**UPOLU WELL DEVELOPMENT, 0.5 MG RESERVOIR, AND TRANSMISSION LINE**  
**North Kohala, Island of Hawaii, Hawaii**  
**BASE BID**

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	TOTAL
80	80	L.F.	Roof - Waterstop @ Slab Joint		
81	4900	S.F.	Roof - Fluid Applied Roofing System		
82	1	EA	Roof - Roof Opening (4'x6') w/ Access Hatch		
83	1	EA	Roof - Observation Hatch (2' x 2')		
84	1	EA	Roof - Aluminum Roof Ventilator		
85	40	L.F.	Roof - Galvanized Steel Guardrailing		
86	2	EA	Roof - S.S. Safety Anchors		
87	27	L.F.	Ladders - Galv Steel Exterior Ladder + Rails		
88	26	L.F.	Ladders - S.S. Interior Ladder + Extension		
89	L.S.		Water Level Indicator and Supports		
90	L.S.		Disinfection of Interior @ Leak Test		
<b>Subtotal for CONVENTIONALLY REINFORCED CONCRETE RESERVOIR (Items 62 to 90)</b>					
91	L.S.		Project Sign, in place complete		
92	Allowance		Field Office		\$10,000.00
93	L.S.		Mobilization and demobilization (not to exceed 10% of the Subtotal Base Bid, Items 1 to 92)		
<b>TOTAL BASE BID (Items 1 to 93)</b>					

## **RECYCLED PRODUCTS PREFERENCE**

This project allows a 10% price preference for recycled products in accordance with HRS 103D-1005. Please indicate your selection of recycled or non-recycled product by indicating its cost FOB jobsite unloaded in the schedule below, including applicable General Excise & Use Taxes.

<u>DESCRIPTION</u>	<u>RECYCLED PRODUCT COST</u>	<u>NONRECYCLED PRODUCT COST</u>
_____	\$ _____	\$ _____
_____	\$ _____	\$ _____
_____	\$ _____	\$ _____
_____	\$ _____	\$ _____

The bidder requesting a recycled product preference shall also complete and submit the form "CERTIFICATION OF RECYCLED CONTENT" as shown in the Interim General Conditions and provide all supporting information with this proposal. Additional information may be requested to qualify a product.

The following definitions are applicable to the CERTIFICATION OF RECYCLED CONTENT form:

"Post-consumer recovered material" means any product used by a consumer, including a business that purchases the material, that has served its intended end use, and that has been separated or diverted from the solid waste stream for the purpose of use, reuse, or recycling.

"Product" includes materials, manufactures, supplies, merchandise, goods, wares, and foodstuffs.

"Recovered material" means waste material and by-products that have been separated, diverted, or removed from the solid waste stream after a manufacturing process for the purpose of use, reuse, or recycling. Recovered material does not include those materials and by-products that are generated and normally reused on-site or within original manufacturing processes (such as mill broke, in the case of paper products).

"Recycled content" means the percentage of a product composed of recovered material, or post-consumer recovered material, or both.

"Recycled product" means a product containing recovered material, or post-consumer recovered material, or both.

The bidder agrees that preference for recycled products shall be taken into consideration to determine the low bidder in accordance with said Section and the rules promulgated, however, the award of contract will be in the amount of the bid offered exclusive any preference.

## **APPRENTICESHIP AGREEMENT PREFERENCE**

1. If applicable to this project, any bidder seeking the preference must be a party to an apprenticeship agreement registered with the State Department of Labor and Industrial Relations (DLIR) at the time the bid is submitted for each apprenticeable trade the bidder will employ to construct the project. “Employ” means the employment of a person in an employer-employee relationship.
  - a. The apprenticeship agreement shall be registered with the DLIR and conform to the requirements of Hawaii Revised Statutes Chapter 372.
  - b. Subcontractors do not have to be a party to an apprenticeship agreement for the bidder to obtain preference.
  - c. The bidder is not required to have apprentices in its employ at the time the bid is submitted to qualify for the preference.
2. A bidder seeking the preference must state the apprenticeable trade the bidder will employ for each trade to be employed to perform the work by submitting a completed signed original Certification Form 1 verifying participation in an apprenticeship program registered with DLIR. “Apprenticeable trade” shall have the same meaning as “apprenticeable occupation” pursuant to Hawaii Administrative Rules (HAR) §12-30-5.
  - a. The *Certification Form 1* shall be authorized by an apprenticeship sponsor listed on the DLIR list of registered apprenticeship programs. “Sponsor” means an operator of an apprenticeship program and in whose name the program is approved and registered with the DLIR pursuant to HAR §12-30-1.
  - b. The authorization shall be an original signature by an authorized official of the apprenticeship sponsor.
  - c. The completed signed original Certification Form 1 for each trade must be submitted with the bid. Previous certifications shall not apply.
  - d. When filling out the *Certification Form 1*, the name of Apprenticeable Trade and Apprenticeship Sponsor must be the same as recorded in the List of Construction Trades in Registered Apprenticeship Programs that is posted on the DLIR website. “Registered apprenticeship program” means a construction trade program approved by the DLIR pursuant to HAR §12-301 and §12-30-4.
  - e. The *Certificate Form 1* and the List of Construction Trades in Registered Apprenticeship Programs is available on the DLIR website at: <http://hawaii.gov/labor/wdd>.
3. Upon receiving the *Certification Form 1*, the Procurement Officer will verify that the apprenticeship program is on the List of Construction Trades in Registered Apprenticeship Programs and that the form is signed by an authorized official of the Apprenticeship Program Sponsor. If the programs and signature are not confirmed by the DLIR, the bidder will not qualify for the preference.
4. If the bidder is certified to participate in an apprenticeship program for each trade which will be employed by the bidder for the project, a preference will be applied to decrease the bidder’s bid

amount by five percent (5%) for evaluation purposes.

5. Should the bidder qualify for other preferences, all applicable preferences shall be applied to the bid price.

**CONTRIBUTIONS BY STATE AND COUNTY CONTRACTORS PROHIBITED**

Contractors are hereby notified of the applicability of Section 11-355, HRS, which states that campaign contributions are prohibited from specified State or county government contractors during the term of the contract if the contractors are paid with funds appropriated by a legislative body.

## **CONDITION OF AWARD**

It is understood that the award of the contract will be made on the basis of the lowest responsible Total Base Bid (Items 1 to 93) selected by the Board of Land and Natural Resources. Write the total of bid items 1 to 93 on page P-1.

In the event the low bid is below the available funds certified by the appropriate fiscal officer, the head of the purchasing agency responsible for the procurement in question is authorized to award Additives to the lowest bidder. The award of Additives may be in any order or combination such that the Base Bid plus Additives do not exceed the available funds.

It is understood and agreed that the Board of Land and Natural Resources reserves the right to reject any and/or all bids and waive any defects when, in the Board's opinion, such rejection or waiver will be for the best interest of the State of Hawaii.

In the event all bids exceed available funds certified by the appropriate fiscal officer, the head of the purchasing agency responsible for the procurement in question is authorized in situations where time or economic considerations preclude resolicitation of work of a reduced scope to negotiate an adjustment of the bid price, including changes in the bid requirements, with the low responsible and responsive bidder, in order to bring the bid within the amount of available funds. It is understood and agreed upon that the head of the purchasing agency may delete a portion or all of any item(s) in the proposal at the stated unit or lump sum price as necessary to stay within the available funding. The bidder is responsible to make an earnest effort to represent the actual cost of each item, including all materials, labor, equipment, overhead and profit in their bid proposal to preclude claims of anticipated profit or loss of profit because of an unbalanced bid proposal.

It is also understood that if a mutually agreeable cost for the reduced scope of work necessitated by a lack of available funds cannot be agreed upon between the bidder and the head of the purchasing agency within 14 calendar days after the bid opening, then the bid may be rejected in the best interest of the purchasing agency, and the head of the purchasing agency may negotiate in progressive order (lowest to highest) with the next lowest responsible and responsive bidder.

It is also understood and agreed that the award of the contract shall be conditioned upon funds being made available for this project and further upon the right of the Board of Land and Natural Resources to hold all bids received for a period of one hundred eighty (180) days from the date of the opening thereof, unless otherwise required by law, during which time no bid may be withdrawn.

It is also understood that Notice to Proceed may be delayed up to one (1) year after the bid opening date, and that no additional compensation will be provided for any claim for escalation or delay for issuance of Notice to Proceed on or before that date.

It is also understood and agreed that the quantities given herewith are approximate only and are subject to increase or decrease, and that the undersigned will perform all quantities of work as either increased or decreased, in accordance with the provisions of the Contract Specifications.

It is also understood and agreed that the estimated quantities shown for the items for which a UNIT PRICE is asked in this Proposal are only for the purpose of comparing on a uniform basis, bids offered for the work under this contract, and the undersigned agrees that he is satisfied with and will at no time, dispute said estimated quantities as a means of claims for anticipated profit or loss of profit, because of a difference between the quantities of the various classes of work done or the materials and equipment installed, and the said estimated quantities. On UNIT PRICE bids, payment will be made only for the actual number of units incorporated into the finished project at the contract UNIT PRICE.

After the HIEPRO bid due date and time, the figures will be extended and/or totaled in accordance with the bid prices of the acceptable proposals and the totals will be compared. In the comparison of bids, words written in the proposal shall govern over figures and unit prices will govern over totals. Until the award of the contract, however, the right will be reserved to reject any and all proposals and to waive any defects or technicalities as may be deemed best for the interest of the State.

It is also understood and agreed that liquidated damages in the amount of Five Hundred and 00/100 dollars (\$500.00) for each and every calendar day in excess thereof prior to completion of the contract shall be withheld from payments due to the Contractor.

It is also understood and agreed that if this bid is accepted, the successful bidder must enter into and execute a contract with the Board of Land and Natural Resources and furnish a Performance and Payment Bond, as required by law. These bonds shall conform to provisions of Section 103D-324 and 325, Hawaii Revised Statutes and any law applicable hereto.

It is also understood and agreed that the successful bidder will provide all necessary labor, materials, tools, equipment, and other incidentals necessary to do all the work and furnish all the materials specified in the contract in the manner and time herein prescribed, and according to the requirements of the Engineer as therein set forth.

It is understood that by submitting this proposal, the undersigned is declaring that his firm has not been assisted or represented on this matter by an individual who has, in a State capacity, been involved in the subject matter of this contract in the past two years.

It is understood that by submitting this proposal in accordance with HAR 3-122-192, the undersigned is declaring that the price submitted is independently arrived without collusion.

It is also understood that by submitting this proposal, a Certification for Safety and Health Programs for bids in excess of \$100,000 (in accordance with HRS 396-18), the undersigned certifies that his organization will have a written safety and health plan for this project that will be available and implemented by the Notice to Proceed date of this project. Details of the requirements of this plan may be obtained from the Department of Labor and Industrial Relations, Occupational, Safety and Health Division (HIOSH).

It is further understood and agreed that the successful bidder shall comply with paragraph 3.1.a "SUBCONTRACTING" of the General Provisions which requires that the contractor shall perform with his own organization and with the assistance of workmen under his immediate superintendence, work of a value not less than twenty percent (20%) of the value of all work embraced in the Contract, except that certain contract items of work, if specifically referred to in the special provisions, will be exempted from said twenty percent requirement.

Compliance with §103-310 HRS. As a condition of award all bidders shall comply with all laws governing entities doing business in the State, including Chapter 237 HRS (general excise tax); Chapter 383 HRS (employment security – unemployment insurance); Chapter 386 HRS (workers compensation); Chapter 392 HRS (temporary disability insurance); and Chapter 393 HRS (pre-paid health care), and shall produce all documents to the State (DLNR, Engineering Division) required to demonstrate compliance with these subsections. Any bidder making a false affirmation or certification under this subsection shall be suspended and may be debarred from further offerings or awards pursuant to §103D-702 HRS.



## **RECEIPT OF ADDENDA**

The bidder also acknowledges receipt of any and all addenda issued by the Engineering Division, by recording the date of receipt of the respective addenda in the space provided below:

<u>Addendum</u>	<u>Date Received</u>	<u>Addendum</u>	<u>Date Received</u>
No. 1	_____	No. 5	_____
No. 2	_____	No. 6	_____
No. 3	_____	No. 7	_____
No. 4	_____	No. 8	_____

It is understood that failure to receive any such addendum shall not relieve the Contractor from any obligation under this Proposal as submitted.

It is also understood and agreed that if this Proposal is accepted and the undersigned should fail or neglect to contract as aforesaid, the Board may determine that the bidder has abandoned the Contract, and thereupon, forfeiture of the security accompanying his proposal shall operate and the same shall become the property of the Board.

## **JOINT CONTRACTORS OR SUBCONTRACTORS TO BE ENGAGED ON THIS PROJECT**

The Bidder agrees that the following is a complete listing of all joint contractors or subcontractors covered under Chapter 444, Hawaii Revised Statutes (HRS), who will be engaged by the Bidder on this project to perform the required work indicated pursuant to Section 103D-302, HRS. It is the sole responsibility of the contractor to review the requirements of this Project and determine the appropriate licenses that are required to complete the Project. The Bidder certifies that the completed listing of joint contractors or subcontractors fulfills the requirements for the project and the Bidder, together with the listed subcontractors or joint contractors have all the specialty contractor's licenses to complete the work, except as provided for in HRS §103D-302(b). Failure of the Bidder to comply with this requirement may be just cause for rejection of the bid.

“A” General Engineering Contractors and “B” General Building Contractors are reminded that due to the Hawaii Supreme Court's January 28, 2002 decision in Okada Trucking Co., Ltd. v. Board of Water Supply, et al., 97 Haw. 450 (2002), they are prohibited from undertaking any work, solely or as part of a larger project, which would require the general contractor to act as a specialty contractor in any area in which the general contractor has no license. Although the “A” and “B” contractor may still bid on and act as the “prime” contractor on an “A” or “B” project (See, HRS §444-7 for the definitions of an “A” and “B” project.), respectively, the “A” and “B” contractor may only perform work in the areas in which they have the appropriate contractor's license (*An “A” or “B” contractor obtains “C” specialty contractor's licenses either on its own, or automatically under HAR § 16-77-32*). The remaining work must be performed by appropriately licensed entities.

General Engineering “A” Contractors automatically have these “C” specialty contractor's licenses: C-3, C-9, C-10, C-17, C-24, C-31a, C-32, C-35, C-37a, C-37b, C-38, C-43, C-49, C-56, C-57a, C-57b and C-61.

General Building “B” Contractors automatically have these “C” specialty contractor's licenses: C-5, C-6, C-10, C-12, C-24, C-25, C-31a, C-32a, C-42a and C-42b.

In completing the Joint Contractors or Subcontractors List, describe the specialty contractor's nature and scope of work to be performed for this project and provide the complete firm name of the joint contractor or subcontractor in the respective columns. If the Bidder is a general contractor and providing the work of the required specialty contractor, fill in the Bidder's (general contractor's) name and nature and scope of work to be performed on this project.

List only one joint contractor or subcontractor per required specialty contractor's classification, unless within the same specialty, the work of each joint contractor or subcontractor can be described so that there is no overlap in work descriptions.

If a contractor's license is required by law for the performance of the work which is called for in this bid, the bidder and all subcontractors must have the required license before the submission of the bidder's proposal in the case of a non-federal aid project, and for federal-aid projects, the bidder must have the required license prior to the award of the project and all subcontractors prior to the start of the subcontracted work.

COMPLETE FIRM NAME OF JOINT CONTRACTOR OR SUBCONTRACTOR	NATURE AND SCOPE OF WORK TO BE PERFORMED

Enclosed herewith is a:

- |    |                             |   |        |
|----|-----------------------------|---|--------|
| 1. | Surety Bond (*1)            | ) |        |
| 2. | Legal Tender (*2)           | ) |        |
| 3. | Cashier's Check (*3)        | ) |        |
| 4. | Certificate of Deposit (*3) | ) | in the |
| 5. | Certified Check (*3)        | ) | amount |
| 6. | Official Check (*3)         | ) | of     |
| 7. | Share Certificate (*3)      | ) |        |
| 8. | Teller's Check (*3)         | ) |        |
| 9. | Treasurer's Check (*3)      | ) |        |

(Cross Out Those Not Applicable)

\_\_\_\_\_ Dollars (\$\_\_\_\_\_)

as required by law.

Respectfully submitted,

\_\_\_\_\_  
Name of Company, Joint Venture  
or Partnership

\_\_\_\_\_  
Contractor's License No.

By \_\_\_\_\_  
Signature (\*4)

Title \_\_\_\_\_

Print Name \_\_\_\_\_

Date \_\_\_\_\_

Address \_\_\_\_\_

\_\_\_\_\_  
Telephone No. \_\_\_\_\_

E-Mail Address \_\_\_\_\_

NOTES:

1. Surety bond underwritten by a company licensed to issue bonds in this State;
2. Legal tender; or
3. A certificate of deposit; share certificate; or cashier's, treasurer's, teller's, or official check drawn by, or a certified check accepted by, and payable on demand to the State by a bank, a savings institution, or credit union insured by the Federal Deposit Insurance Corporation or the National Credit Union Administration.
  - A. These instruments may be utilized only to a maximum of \$100,000.
  - B. 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.
4. Please attach to this page evidence of the authority of this officer to submit bids on behalf of the Company and also the names and residence addresses of all officers of the Company.
5. Fill in all blank spaces with information asked for or bid may be invalidated. PROPOSAL MUST BE INTACT, MISSING PAGES MAY INVALIDATE YOUR BID.

**End of Proposal**

# TECHNICAL SPECIFICATIONS

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Upolu Well Development, 0.5 MG Reservoir, and Transmission Main

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END OF SECTION

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Upolu Well Development, 0.5 MG Reservoir, and Transmission Main

## SECTION 01019

### GENERAL SPECIFICATIONS

#### PART 1 - GENERAL

##### 1.1 GENERAL REQUIREMENTS

Work shall consist of furnishing all labor, tools, materials and equipment necessary and required to construct in place complete all work as indicated on the drawings and as specified herein.

##### 1.2 GENERAL

- A. Examination of Premises: The Contractor shall contact the Engineer and obtain permission before visiting the site.
- B. All lines and grades shall be established by a licensed surveyor, or licensed Civil Engineer, registered in the State of Hawaii. The Contractor shall submit evidence of current and valid registration.
- C. Notices: The Contractor shall notify the Engineer and give at least three (3) working days notice before starting any work.
- D. Disruption of Utility Services: All work related to the temporary disconnection of electrical system shall be pre-arranged with the Engineer so that any disruption of such services will be kept to a minimum. In the event temporary power hook-up is required, the Contractor shall provide the necessary services.
- E. Contractor's Operations
  - 1. The Contractor must employ, insofar as possible, such methods and means of carrying out the work so as not to cause any interruption or interference to the facility's operations. Where the Contractor's operations would result in interruptions which would hamper the operations of the facilities, the Contractor shall rearrange the schedule of work accordingly.
  - 2. The Contractor shall maintain safe passageway to and from the facility for the user agency personnel and the public at all times.
- F. Lead Paint
  - 1. When the project includes paint to be disturbed that was applied prior to 1980, it shall be assumed to contain lead. The Contractor shall inform its employees,

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Upolu Well Development, 0.5 MG Reservoir, and Transmission Main



subcontractors, and all other persons engaged in the project that lead containing paints are present in the existing buildings at the job site and to follow the requirements of the Department of Labor and Industrial Relations, Division of Occupational Safety and Health, Title 12, Subtitle 8, Chapter 148, Lead Exposure in Construction, Hawaii Administrative Rules (Chapter 12-148, HAR).

G. Parking Policy for Contractor

1. The Contractor and its employees will not be allowed to park in zones assigned to facility personnel.
2. Areas to be used by the Contractor shall be as designated by the Engineer. Any lawn damaged by the Contractor shall be restored as instructed by the Engineer at no cost to the State.

H. Toilet Accommodations: The Contractor may use the existing toilet facilities if so designated by the Engineer; however, it is the Contractor's responsibility to keep same clean and in a sanitary condition at all times.

I. Protection of Property: The Contractor shall continually maintain adequate protection of all its work from damage and shall protect all property, including but not limited to buildings, equipment, furniture, grounds, vegetation, material, utility systems located at and adjoining the job site. The Contractor shall repair, replace or pay the expense of repair of damages resulting from its operations.

J. Use of Power Driven Equipment: The Contractor is cautioned to take all necessary safety precautions to protect the facility personnel, and the public whenever power driven equipment is used.

K. Safety: The Contractor shall carefully read and strictly comply with the requirements of the Hawaii Occupational Safety and Health Law, Chapter 396, Hawaii Revised Statutes, as amended, is applicable and made a part of the Contract.

L. Clean Up Premises: The Contractor shall clean up and remove from premises all debris accumulated from operations as necessary or as directed. See also Section 7.25 of the General Conditions.

M. Responsibility

1. The State will hold the Contractor liable for all the acts of Subcontractors and shall deal only with the prime Contractor in matters pertaining to other trades employed on the job. The Contractor shall be responsible for coordinating the work of all trades on the job.

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Upolu Well Development, 0.5 MG Reservoir, and Transmission Main

2. Should the Contractor discover any discrepancy in the plans or specifications, the Contractor shall immediately notify the Engineer before proceeding any further with the work, otherwise, the Contractor will be held responsible for any cost involved in correction of work placed due to such discrepancy.
- N. Cooperation With Other Contractors: The State reserves the right at any time to contract for or otherwise perform other or additional work within the contract zone limits of this Contract. The Contractor of this project shall, to the extent ordered by the State, conduct its work so as not to interfere with or hinder the progress or completion of the work performed by other contractors.
- O. Division of the Work: The Divisions and Sections into which these Specifications are divided shall not be considered an accurate or complete segregation of work by trades. This also applies to all work specified within each Section.
- P. Drawings and Specifications
1. The Contractor shall not make alterations in the drawings and specifications. In the event the contractor discovers any errors or discrepancies, the Contractor shall immediately notify the Engineer in accordance with the General Conditions.
  2. Where devices, or items, or parts thereof are referred to in the singular, it is intended that such reference shall apply to as many such devices, items or parts as are required to properly complete the work.
  3. Specifications and drawings are prepared in abbreviated form and include incomplete sentences. Omission of words or phrases such as "the Contractor shall", "as shown on the drawings", "a", "an", and "the" are intentional. Omitted words and phrases shall be provided by inference to form complete sentences.
- Q. Required Submittals
1. Required submittals as specified in the Technical Sections of these specifications include one or more of the following: Shop drawings; color samples; material samples; technical data; schedules of materials; schedules of operations; guarantees; operating and maintenance manuals; and as-built drawings.
  2. The Contractor shall make a comprehensive list of the required submittals, by Specification Section, and submit this list to the Engineer within 15 days after notice to proceed.
  3. As-Built Drawings: When as-built drawings are required for submittal, the following shall apply:

General Specifications  
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- a. As-built drawings, the intent of which is to record the actual in-place construction so that any future renovations or tie-ins can be anticipated accurately, shall be required.
- b. All deviations from alignments, elevations and dimensions which are stipulated on the plans shall be recorded in red on the as-built drawings.
- c. The following procedure shall be followed:
  - 1) Immediately after these changes are constructed in place, the Contractor shall record them on the field office plans.
  - 2) Within two weeks after final inspection of the project, the Contractor shall transfer the changes marked on the field office plans onto a clean copy of plans using a red pencil. Any deletions shall be so noted and redrawn as necessary. The Contractor shall stamp or mark the tracings "AS-BUILT", and also sign and date each drawing so marked.
  - 3) The Contractor shall submit the as-built drawings to the Engineer for review and approval. After the Engineer approves the as-built drawings, the Contractor shall submit an electronic copy in Adobe PDF format on CD ROM.
  - 4) Any as-built drawing which the Engineer determines does not accurately record the deviation shall be corrected by the State, and the Contractor shall be charged for the services.

END OF SECTION

General Specifications  
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## SECTION 01090

### STANDARD REFERENCES

#### PART 1 - GENERAL

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

<u>Abbreviation</u>	<u>Company</u>
AA	Aluminum Association Incorporated 818 Connecticut Avenue, N.W. Washington, D.C. 20006
AASHTO	American Association of State Highway and Transportation Officials 444 North Capitol Street, N.W., Suite 225 Washington, D.C. 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, D.C.
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

#### Standard References

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<u>Abbreviation</u>	<u>Company</u>
AITC	American Institute of Timber Construction 333 West Hampden Avenue Englewood, CO 80110
AMCA	Air Moving and Conditioning 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 1430 Broadway New York, NY 10018
ASE Code	American Standard Safety Code for Elevators, 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

Standard References

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<u>Abbreviation</u>	<u>Company</u>
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

#### Standard References

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<u>Abbreviation</u>	<u>Company</u>
DIS	Division of Industrial Safety California Department of Industrial Relations 2422 Arden Way Sacramento, CA 95825
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
ESO	Electrical Safety Orders, California Administrative Code, Title 8, Chap. 4, Subarticle 5 Office of Procurement, Publications Section P.O. Box 20191 8141 Elder Creek Road Sacramento, CA 95820
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

#### Standard References

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<u>Abbreviation</u>	<u>Company</u>
HI	Hydraulic Institute 1230 Keith Building Cleveland, OH 44115
IAPMO	International Association of Plumbing and Mechanical Officials 5032 Alhambra Avenue Los Angeles, CA 90032
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

#### Standard References

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<u>Abbreviation</u>	<u>Company</u>
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
NFPA	National Forest Products Association (Formerly called: National Lumber Manufacturer's Association) 1619 Massachusetts Avenue, N.W. Washington, DC 20036
OSHA	Occupational Safety and Health Act U.S. Department of Labor San Francisco Regional Office 450 Golden Gate Avenue, Box 36017 San Francisco, CA 94102
PPIC	The Plumbing & Piping Industry Council, Inc. Suite 402 510 Shatto Place Los Angeles, CA 90020
SAE	Society of Automotive Engineers 2 Pennsylvania Street New York, NY 10001

#### Standard References

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<u>Abbreviation</u>	<u>Company</u>
SAMA	Scientific Apparatus Makers Association One Thomas Circle Washington, DC 20005
SBCC	Southern Building Code Congress 1116 Brown-Marx Building Birmingham, AL 35203
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
UBC	Uniform Building Code Published by ICBO
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 Lumberman's Association - WCLA) Yeon Building Portland, CA 97204

Standard References

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PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

- END OF SECTION -

Standard References  
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Upolu Well Development, 593' 0.5 MG Reservoir, and Transmission Main

## SECTION 01100

### ARCHAEOLOGICAL PROTECTION

#### PART 1 - GENERAL

- 1.1 This section covers the requirements for the protection and preservation of historical sites and values.

#### PART 2 - PRODUCTS (NOT USED)

#### PART 3 - EXECUTION

##### 3.1 CONSTRUCTION METHOD

Representatives of the State will from time to time examine the area as work proceeds. If historical values are noted, the State may order a halt to the work in the vicinity of the historical values until the State can examine further. The Contractor shall notify the State if he finds anything he suspects to be of historic significance and shall discontinue further work in the vicinity of the find until the State can examine the area. In either case, further work in the vicinity of such historical or suspected historical values may proceed only upon approval by the State. Such approval can be normally expected within one week and shall in no case require more than one month.

END OF SECTION

Archaeological Protection  
01100-1

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## SECTION 01300

### SUBMITTALS

#### PART 1 - GENERAL

##### 1.1 SUBMITTALS

A. Shop drawings shall be required for:

1. Division 1 – General Requirements
2. Division 2 – Site Construction
3. Division 3 – Concrete
4. Any others as called for in the plans, specifications or as required by the Engineer.

B. Other required submittals shall include:

1. Manufacturer's Data.
2. Certificates of Warranty.
3. Any others as called for in the plans, specifications, or as required by the Engineer.

##### 1.2 BIDDER'S SPECIAL RESPONSIBILITY FOR COORDINATING CONTRACTUAL WORK AND SUBMITTALS:

A. The Contractor is responsible for the coordination of all contractual work and submittals.

B. The Contractor shall have a rubber stamp made up in the following format:

#### CONTRACTOR NAME

PROJECT: \_\_\_\_\_

\_\_\_\_\_

JOB NO: \_\_\_\_\_

THIS SUBMITTAL HAS BEEN CHECKED BY THIS GENERAL CONTRACTOR. IT IS CERTIFIED CORRECT, COMPLETE, AND IN COMPLIANCE WITH CONTRACT DRAWINGS AND SPECIFICATIONS. ALL AFFECTED CONTRACTORS AND SUPPLIERS ARE AWARE OF, AND WILL

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INTEGRATE THIS SUBMITTAL INTO THEIR OWN WORK.

DATE RECEIVED \_\_\_\_\_  
SPECIFICATION SECTION \_\_\_\_\_  
SPECIFICATION PARAGRAPH \_\_\_\_\_  
DRAWING NUMBER \_\_\_\_\_  
SUBCONTRACTOR NAME \_\_\_\_\_  
SUPPLIER NAME \_\_\_\_\_  
MANUFACTURER NAME \_\_\_\_\_

CERTIFIED BY: \_\_\_\_\_

- C. This stamp, "filled in", should appear on the title sheet of each shop drawing, on a cover sheet of submittals in an 8-1/2" x 11" format, or on one face of a cardstock tag (min. 3" x 6") tied to each sample. The tag on the samples should state what the sample is so that, if the tag is accidentally separated from the sample, it can be matched up again. The back of this tag will be used by the Engineer for his receipt, review, and log stamp and for any comments that relate to the sample.
- D. All submittals for material, equipment, and shop drawings listed in the contract documents, including dimensioned plumbing shop drawings, shall be required and shall be reviewed by the Engineer, prior to any ordering of materials and equipment.
- E. Unless otherwise noted, the Contractor shall submit to the Engineer for his review eight copies of all shop drawings, piping layout, and/or catalog cuts for fabricated items and manufactured items (including mechanical and electrical equipment) required for the construction. Drawings shall be submitted in sufficient time to allow the Engineer not less than twenty regular working days for examining the drawings.
- F. The drawing 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.
- G. Unless otherwise approved by the Engineer, shop drawings shall be submitted only by the Contractor, who shall indicate by a signed stamp on the drawings or other approved means that the Contractor has checked the shop drawings and that the work or equipment shown is in accordance with contract requirements and has been checked for dimensions and relationship with work of all other trades involved. All deviations from the plans and specifications shall be listed. The practice of submitting incomplete or unchecked shop drawings for the Engineer to correct or finish will not be acceptable, and shop drawings which, in the opinion of the Engineer, clearly indicate that they have not been checked by the Contractor will be considered as not complying with the intent of the contract documents and will be returned to the Contractor for resubmission in the proper form.

Submittals  
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- H. When the shop drawings have been reviewed by the Engineer, two sets of submittals will be returned to the Contractor appropriately stamped. If major changes or corrections are necessary, the drawing may be rejected and one set will be returned to the Contractor with such changes or corrections indicated, and the Contractor shall correct and resubmit eight copies of the drawings, unless otherwise directed by the Engineer. No changes shall be made by the Contractor to the resubmitted shop drawings other than those changes indicated by the Engineer. The resubmittal shall be so indicated on the shop drawing.
- I. The review of such drawings and catalog cuts by the Engineer shall not relieve the Contractor from responsibility for correctness of the dimensions, fabrication details, and space requirements or for deviations from the contract drawings and specifications, unless the Contractor has called attention to such deviations, in writing, by a letter accompanying the drawings and the Engineer approved the change or deviations, in writing, at the time of submission; nor shall review by the Engineer relieve the Contractor from the responsibility for errors in the shop drawings. When the Contractor does call such deviations to the attention of the Engineer, he shall state in his letter whether or not such deviations involve any deduction or extra cost adjustment.
- J. The approval of the above drawings, lists, prints, specifications, or other data shall in no way release the Contractor from his responsibility for the proper fulfillment of the requirements of this contract nor for fulfilling the purpose of the installation nor from his liability to replace the same should it prove defective or fail to meet the specified requirements.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

Submittals  
01300 - 3

Job No. G25CH17A

Upolu Well Development, 593' 0.5 MG Reservoir, and Transmission Main

## SECTION 01530

### BARRICADES

#### PART 1 - GENERAL

##### 1.1 GENERAL REQUIREMENTS

- A. Description. This work shall consist of furnishing, installing and maintaining barricades in accordance with the requirements of the contract.

Barricade application shall be provided for in the latest edition of the FHWA publication, Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD), and as amended.

#### PART 2 - PRODUCTS

##### 2.1 MATERIALS

- A. Lumber: Lumber for rails, frames and braces shall be dry, sound, undamaged, well seasoned, and free from any defect which may impair their strength and durability.
- B. Hardware: Nails shall be galvanized wire nails. As many and as large a size as is practicable shall be used.
- C. Paints: Paints shall be exterior enamel paint of the best grade or first line as made by approved manufacturers.
- D. Sheet Reflecting Material: Sheet reflecting material shall conform to the applicable requirements of Subsection 712.20(C) of the "Standard Specifications for Road and Bridge Construction".
- E. Alternate Designs: Alternate barricade designs such as plastic molded barricades may be used subject to the Engineer's approval. The Contractor shall submit shop drawings or catalog cuts for approval.

#### PART 3 - EXECUTION

##### 3.1 CONSTRUCTION REQUIREMENTS

- A. General: Barricades shall be constructed in a first class, workmanlike manner in accordance with details shown on the plans and as specified herein.

Barricades  
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Barricades shall be in good condition and approved by the Engineer for use within the project limits. Barricade application and installation shall be as shown on the plans and as the FHWA publication, Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD), and any amendments or revisions thereof as may be made from time to time.

Sand bags or other approved weights shall be provided where required or as directed by the Engineer. Sand bags or other approved weights shall not be placed on any striped barricade rail.

Steady burn and/or flashing lamps shall be required on selected barricades used during hours of darkness. Locations shall be as shown on the plans and as directed by the Engineer. Lamps shall be attached on the barricade ends closest to the traveled way and shall be visible to the motorist.

Barricades furnished and paid for as provided for as provided herein may be used for temporary detours, construction phasing, or other temporary traffic control work.

Barricades furnished and paid for use in temporary detours or construction phasing may be used for permanent location called for on the plans.

Upon completion of the construction work, barricades shall be left in place, relocated, or removed and disposed of as shown on the plans or as directed by the Engineer. Barricades left in place, or relocated to new permanent locations shall become the property of the State. Barricades directed to be removed and disposed of shall become the property of the Contractor.

- B. Painting: Wooden rails, frames and braces shall be given a prime coat and 2 finish coats of new white exterior enamel paint. Rail faces to be reflectorized may be left unpainted unless otherwise specified or directed.
- C. Reflectorization: Reflectorization of barricade rails shall be done in a first class, workmanlike manner and the attachment of reflective sheeting shall be as shown on the plans, specified herein, or as directed and approved by the Engineer.

Both vertical faces of each barricade rail shall be reflectorized as shown on the plans.

Wooden rails shall be reflectorized with one of the following:

1. Reflective sheeting specified in Subsection 712.20(C)(4) of the "Standard Specifications for Road and Bridge Construction" and backed with a 26 gage galvanized steel sheet, or
2. A hardened aluminum backed reflective sheeting as specified in Subsection 712.20(C)(5) of the "Standard Specifications for Road and Bridge Construction."

Barricades  
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- D. Color: Rails, frames and braces shall be white.

The front and back faces of barricade rails shall have 6-inch wide alternative colored and white striped sloping downward toward the traveled way at an angle of 45 degrees with the vertical. The colored stripes shall be either orange or red in accordance with the following requirements:

1. Orange and white stripes shall be used in the following conditions:
  - a. Construction work.
  - b. Detours.
  - c. Maintenance work.
2. Red and white stripes shall be used in the following conditions:
  - a. On roadways with no outlet (ie. dead-ends, cul-de-sacs).
  - b. Ramps or lanes closed for operational purposes.
  - c. Permanent or semipermanent closure or termination of a roadway.

- E. Maintenance: Barricades shall be kept in good condition throughout their usage during construction until the end of the contract.
- F. The Contractor shall repair, repaint, clean or replace the barricades as required and as directed by the Engineer to maintain their effectiveness and appearance.

The Constructor shall immediately replace all lost, stolen or damaged barricades, lamps, sand bags and other approved weights.

Barricades used during construction phasing, temporary detours or other temporary traffic control work shall be cleaned and repaired as necessary, prior to being relocated to a permanent location shown on the plans or as directed.

No extra payment will be made for any repair work, repainting, or cleaning of barricades. The Engineer shall determine the suitable condition of each barricade and shall determine when each barricade shall be repaired, repainted or cleaned.

END OF SECTION

Barricades  
01530-3

## SECTION 01560

### ENVIRONMENTAL PERMITS AND CONTROLS

#### PART 1 – GENERAL

- 1.01 SCOPE: With the exception of those measures set forth elsewhere in these specifications, environmental protection shall consist of the prevention of environmental pollution as the result of construction operations under this contract. For the purpose of this specification, environmental pollution is defined as the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare, unfavorably alter ecological balances of importance to human life, affect other species of importance to man, or degrade the utilization of the environment for aesthetic and recreational purposes.

The work under this section shall include the following:

1. Provide all air and water quality testing and monitoring work required by the permits during construction.
2. Provide all facilities, equipment and structural controls for minimizing adverse impacts upon the environment during the construction period.

#### 1.02 APPLICABLE REGULATIONS

- A. In order to provide for abatement and control of environmental pollution arising from the construction activities of the Contractor and his subcontractors in the performance of this contract, the work performed shall comply with the intent of the applicable Federal, State and local laws and regulations concerning environmental pollution control and abatement, including, but not limited to the following regulations:
1. State of Hawaii, Department of Health, Administrative Rules, Chapter 1155, WATER POLLUTION CONTROL: Chapter 11-54, WATER QUALITY STANDARDS.
  2. State of Hawaii, Department of Health, Administrative Rules, Chapter 1159, AMBIENT AIR QUALITY: Chapter 11-60, AIR POLLUTION CONTROL LAW.
  3. State of Hawaii, Department of Health, Administrative Rules, Chapter 44A, VEHICULAR NOISE CONTROL.

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4. State of Hawaii, Occupational Safety and Health Standards, Title 12, Department of Labor and Industrial Relations, Subtitle 8, Division of Occupational Safety and Health, Subparagraph 12-202-13, ASBESTOS DUST: Environmental Protection Agency, Code of Federal Regulations Title 40, Part 61, Subpart A, NATIONAL EMISSION STANDARDS FOR AIR POLLUTANTS and Subpart B, NATIONAL EMISSION STANDARDS FOR ASBESTOS; and U.S. Department of Labor Occupational Safety and Health Administration (OSHA) Asbestos Regulations, Code of Federal Regulations Title 29, Part 1910.
5. Rules Relating to Soil Erosion Standards & Guidelines, April 1999, City and County of Honolulu.
6. Chapter 14 Articles 13, 14, 15 and 16 relating to grading, soil erosion, and sediment control of the Revised Ordinances of Honolulu, 1990, as amended.

## PART 2 - PRODUCTS

NONE

## PART 3 - EXECUTION

### 3.01 AIR POLLUTION CONTROL

- A. The Contractor shall comply with Department of Health regulations.
- B. Emission

The Contractor shall not be allowed to operate equipment and vehicles that show excessive emissions of exhaust gases until corrective repairs or adjustments are made, as determined by the Engineer.

### 3.02 WATER POLLUTION CONTROL

- A. Wastes

The Contractor shall not deposit at the site or in the storm drainage system any solid waste or discharge liquid waste, such as fuels, lubricants, bituminous waste, untreated sewage and other pollutants, which may contaminate the existing surface or ground water.

- B. Spillages

Care shall be taken to ensure that no petroleum products, bituminous materials, or other deleterious substances, including debris, are allowed to fall, flow, leach, or otherwise enter existing surface or ground water.

Environmental Permits and Controls

1560-2

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3.04 NOISE CONTROL

- A. Construction equipment shall be equipped with suitable mufflers to maintain noise within levels complying with applicable regulations.
- B. If necessary, a noise permit shall be obtained from the Department of Health.

3.05 SOLID WASTES

- A. Construction waste, such as crates, boxes, building materials, pipes and other rubbish shall be disposed of at sites approved by the County of Hawaii. Large size objects shall be reduced to a size acceptable by the County Specifications for disposal in their landfills.
- B. Removal of wastes shall be a continuous on-going operation. Wastes and debris shall not be allowed to accumulate in large open piles.
- C. Wind-blown wastes and debris and wastes left by workers shall be collected by the Contractor and disposed as described above. No rubbish shall be deposited in the trench excavations for this project or in the existing drainage channels.

—END OF SECTION—

## SECTION 01567

### POLLUTION CONTROL

#### PART 1 - GENERAL

##### 1.1 GENERAL REQUIREMENTS

###### A. Rubbish Disposal

1. No burning of debris and/or waste materials shall be permitted on the project site.
2. No burying of debris and/or waste material except for materials which are specifically indicated elsewhere in these specifications as suitable for backfill shall be permitted on the project site.
3. All unusable debris and waste material shall be hauled away to an appropriate off-site dump area. During loading operations, debris and waste materials shall be watered down to allay dust.
4. No dry sweeping shall be permitted in cleaning rubbish and fines which can become airborne from floors or other paved areas. Vacuuming, wet mopping or wet or damp sweeping is permissible.
5. Enclosed chutes and/or containers shall be used for conveying debris from above to ground floor level.
6. Clean-up shall include the collection of all waste paper and wrapping materials, cans, bottles, construction waste materials and other objectionable materials, and removal as required. Frequency of clean-up shall coincide with rubbish producing events.

###### B. Dust

1. The Contractor shall prevent dust from becoming airborne at all times including non-working hours, weekends and holidays in conformance with the State Department of Health, Administrative Rules, Title 11, Chapter 60 - Air Pollution Control.
2. The method of dust control and costs shall be the responsibility of the Contractor. Methods of dust control shall include the use of water, chemicals or asphalt over surfaces which may create airborne dust.
3. The Contractor shall be responsible for all damage claims in accordance with Section 7.16 - "Responsibility for Damage Claims" of the GENERAL CONDITIONS.

Pollution Control  
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Upolu Well Development, 0.5 MG Reservoir, and Transmission Main

C. Noise

1. Noise shall be kept within acceptable levels at all times in conformance with the State Department of Health, Administrative Rules, Title 11, Chapter 46 - Community Noise Control for Oahu. The Contractor shall obtain and pay for the Community Noise Permit from the State Department of Health when the construction equipment or other devices emit noise at levels exceeding the allowable limits.
2. All internal combustion engine-powered equipment shall have mufflers to minimize noise and shall be properly maintained to reduce noise to acceptable levels.
3. Pile driving operations shall be confined to the period between 9:00 a.m. and 5:30 p.m., Monday through Friday. Pile driving will not be permitted on weekends and legal State and Federal holidays.
4. Starting-up of construction equipment meeting allowable noise limits shall not be done prior to 6:45 a.m. without prior approval of the Engineer. Equipment exceeding allowable noise levels shall not be started-up prior to 7:00 a.m.

D. Erosion

1. During interim grading operations, the grade shall be maintained so as to preclude any damage to adjoining property from water and eroding soil.
2. Temporary berms, cut-off ditches and other provisions which may be required because of the Contractor's method of operations shall be installed at no cost to the State.
3. Drainage outlets and silting basing shall be constructed and maintained as shown on the plans to minimize erosion and pollution of waterways during construction.

E. Others

1. Wherever trucks and/or vehicles leave the site and enter surrounding paved streets, the Contractor shall prevent any material from being carried onto the pavement. Waste water shall not be discharged into existing streams, waterways, or drainage systems such as gutters and catch basins unless treated to comply with the State Department of Health water pollution regulations.
2. Trucks hauling debris shall be covered as required by PUC Regulation. Trucks hauling fine materials shall be covered.
3. No dumping of waste concrete will be permitted at the job-site.

Pollution Control  
01567-2

4. Except for rinsing of the hopper and delivery chute, and for wheel washing where required, concrete trucks shall not be cleaned on the job-site.
5. Except in an emergency, such as a mechanical breakdown, all vehicle fueling and maintenance shall be done in a designated area. A temporary berm shall be constructed around the area when runoff can cause a problem.
6. When spray painting is allowed such spray painting shall be done by the "airless spray" process. Other types of spray painting will not be allowed.

F. Suspension of Work

1. Violations of any of the above requirements or any other pollution control requirements which may be specified in the Technical Specifications herein shall be cause for suspension of the work creating such violation. No additional compensation shall be due the Contractor for remedial measures to correct the offense. Also, no extension of time will be granted for delays caused by such suspensions.
2. If no corrective action is taken by the Contractor within 72 hours after a suspension is ordered by the Engineer, the State reserves the right to take whatever action is necessary to correct the situation and to deduct all costs incurred by the State in taking such action from monies due the Contractor.
3. The Engineer may also suspend any operations which he feels are creating pollution problems although they may not be in violation of the above-mentioned requirements. In this instance, the work shall be done by force account as described in Subsection 4.2b - "Additional Work" of the GENERAL CONDITIONS and paid for in accordance with Subsection 8.4b - "Force - Account Work" therein. The count of elapsed working days to be charged against the contract in this situation shall be computed in accordance with Subsection 7.18 - "Contract Time" of the GENERAL CONDITIONS.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

Pollution Control  
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## SECTION 01581

### PROJECT SIGN

#### PART 1 - GENERAL

##### 1.1 GENERAL REQUIREMENTS

Furnish all labor, materials and equipment necessary to construct and install all project sign as specified hereinafter.

##### 1.2 SUBMITTAL

The contractor shall provide the Engineer with six (6) shop drawings of the project sign for review and approval by the Engineer prior to ordering the sign.

##### 1.3 LETTER STYLE

Copy is centered and set in Adobe Type Futura Heavy. If this specific type is not available, Futura Demi Bold may be substituted. Copy should be set and spaced by a professional typesetter and enlarged photographically for photo stencil screen process.

##### 1.4 ART WORK

Constant elements of the sign layout - frame, outline, stripe, and official state information - may be duplicated following drawing measurements, or be reproduced and enlarged photographically using a layout template if provided. The "STATE OF HAWAII" masthead should be reproduced and enlarged as specified, using the artwork provided.

##### 1.5 TITLES

The specific major work of the project under construction is emphasized by using 3-3/4" type, all capitals. Secondary information such as location or buildings uses 2-1/4" type, all capitals. Other related information of lesser importance uses letter heights as indicated on 01581-3, upper / lower case letters.

Design should follow the example on page 01581-3.

#### PART 2 - PRODUCTS

##### 2.1 MATERIALS

###### A. LUMBER

1. Panel is 3/4" exterior grade high density overlaid plywood, with resin-bonded surfaces on both sides.

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2. 4"x4" sign posts shall be Douglas Fir No. 1 or better.

**B. PAINTS & INKS**

Screen print inks are matte finish. Paints are satin finish, exterior grade. References to Ameritone Color Key Paint are for color match only.

COLOR:	1.	1BL10A	Bohemian Blue
	2.	2H16P	Softly (White)
	3.	2VR2A	Hot Tango (Red)
	4.	1M52E	Tokay (Gray)

**C. CONCRETE**

Concrete shall be class B with a 2,500 psi 28-day compressive strength.

**PART 3 - EXECUTION**

**3.1 GENERAL**

- A. The Project Sign shall be constructed with new materials as specified above.
- B. The Project sign shall be installed at the location indicated on the drawings or as designated by the Engineer. The project sign shall be erected upon commencement of work.

**3.2 MEASUREMENTS AND PAYMENT**

The construction of the project sign, including all equipment, labor and material necessary to furnish and install the project sign will be paid for under the "Project Sign" proposal item.

**END OF SECTION**

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SECTION 01700  
PROJECT CLOSEOUT

PART 1 - GENERAL

1.01 GENERAL CONDITIONS

As specified in Section 00700.

1.02 DESCRIPTION OF WORK:

- A. This section specifies administrative and procedural requirements for project closeout, including by not limited to:
1. Inspection procedures.
  2. Project record document submittal.
  3. Operating and maintenance manual submittal.
  4. Submittal of warranties.
  5. Final cleaning.
- B. Closeout requirements for specific construction activities are included in the appropriate Sections in Divisions-2 through -16.

1.03 SUBSTANTIAL COMPLETION:

- A. Preliminary Procedures: Before requesting inspection for certification of Substantial Completion, Contractor shall complete the following. List exceptions in the request.
1. In the Application of Payment that coincides with, or first follows, the date Substantial Completion is claimed, show 100 percent completion for the portion of the Work claimed as substantially complete. Include supporting documentation for completion as indicated in these Contract Documents and a statement showing an accounting of changes to the Contract Sum.  
  
If 100 percent completion cannot be shown, include a list of incomplete items, the value of incomplete construction, and reasons the Work is not complete.
  2. Advise Owner of pending insurance change-over requirements.
  3. Submit specific warranties, workmanship bonds, maintenance agreements, final certifications and similar documents.
  4. Obtain and submit releases enabling the Owner unrestricted use of the Work and access to services and utilities, operating certificates and similar releases.
  5. Discontinue or change over and remove temporary facilities from the site, along

Project Closeout  
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with construction tools, mock-ups, and similar elements.

6. Complete final clean up requirements.

B. Inspection Procedures: In accordance with AIA 201 - 2007

1.04 RECORD DOCUMENT SUBMITTALS:

A. General: Contractor shall not use record documents for construction purposes; but will protect from deterioration and loss in a secure, fire-resistive location and provide access to record documents for the Engineer's reference during normal working hours.

B. Record Drawings: Contractor shall maintain a clean, undamaged set of blue or black line prints of Contract Drawings and Shop Drawings. Contractor shall mark the set to show the actual installation where the installation varies substantially from the Work as originally shown. Contractor shall mark whichever drawing is most capable of showing conditions fully and accurately; where Shop Drawings are used, record a cross-reference at the corresponding location on the Contract Drawings. Contractor shall give particular attention to concealed elements that would be difficult to measure and record at a later date. Contractor shall also:

1. Mark record sets with red erasable pencil; use other colors to distinguish between variations in separate categories of the Work;
2. Mark new information that is important to the Owner, but was not shown on Contract Drawings or Shop Drawings.
3. Note related Change Order numbers where applicable; and
4. Organize record drawing sheets into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates and other identification on the cover of each set.

C. Record Product Data: Contractor shall maintain one copy of each Product Data submittal. Contractor shall mark these documents to show significant variations in actual Work performed in comparison with information submitted. Include variations in products delivered to the site, and from the manufacturer's installation instructions and recommendations. Contractor shall give particular attention to concealed products and portions of the Work which cannot otherwise be readily discerned later by direct observation. Contractor shall note related Change Orders and mark-up of record drawings and Specifications. Upon completion of mark-up, Contractor shall submit complete set of record Product Data to the Engineer for the Owner's records.

D. Record Specifications: Contractor shall maintain one copy of the Project Manual, including addenda, bulletins, and one copy of other written construction documents such as Change Orders and modifications issued in printed form during construction. Contractor shall mark these documents to show substantial variations in actual Work

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performed in comparison with the text of the Specifications and modifications. Give particular attention to substitutions, selection of options and similar on elements that are concealed or cannot be readily discerned later by direct observation. Contractor shall note related record drawing information and Product Data. Upon completion of the Work, Contractor shall submit record Specifications to the Engineer for the Owner's records.

- E. Record Sample Submitted: Immediately prior to the date or dates of Substantial Completion, the Contractor will meet at the site with the Engineer and the Owner's personnel to determine which of the submitted Samples that have been maintained during progress of the Work are to be transmitted to the Owner for record purposes. Comply with delivery to the Owner's Sample storage area.
- F. Miscellaneous Record Submittals: Contractor shall refer to other Specification Sections for requirements of miscellaneous record-keeping and submittals in connection with actual performance of the Work. Immediately prior to the date or dates of Substantial Completion, Contractor shall complete miscellaneous records and place in good order, properly identified and bound or filed, ready for continued use and reference. Contractor shall submit to the Engineer for the Owner's records.
- G. Maintenance Manuals: Contractor shall organize operating and maintenance data into suitable sets of manageable size. Contractor shall bind properly indexed data in individual heavy-duty 2-inch, 3-ring vinyl-covered binders, with pocket folders for folded sheet information. Contractor shall mark appropriate identification on front and spine of each binder. Contractor shall include the following types of information:
  - 1. Emergency instructions.
  - 2. Spare parts list.
  - 3. Copies of warranties.
  - 4. Wiring diagrams.
  - 5. Recommended 'turn around' cycles.
  - 6. Inspection procedures.
  - 7. Shop Drawings and Product Data.

## PART 2 - PRODUCTS (Not Applicable)

## PART 3 - EXECUTION

### 3.01 CLOSEOUT PROCEDURES

- A. Operating and Maintenance Instructions: Contractor shall arrange for each installer of products or equipment requiring regular maintenance to meet with the Owner's personnel to provide instruction in proper operation and maintenance of that product or equipment. They are to provide a written set of instructions and to meet with the Owner or Owner's personnel to make sure the Owner understands those instructions. The Contractor shall compile such instructions into a Project Manual for Operating and Maintenance Procedures and provide one copy to the Engineer. Contractor shall include a detailed review of the following items:

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1. Maintenance manuals.
2. Record documents.
3. Spare parts and materials.
4. Tools.
5. Lubricants.
6. Fuels.
7. Identification systems.
8. Control sequences.
9. Hazards.
10. Cleaning.
11. Warranties and bonds (include conditions under which any warranty may be voided).
12. Maintenance agreements and similar continuing commitments.

B. As part of instruction for operating equipment, Contractor shall demonstrate the following procedures:

1. Start-up.
2. Shutdown.
3. Emergency operations.
4. Noise and vibration adjustments.
5. Safety procedures.
6. Economy and efficiency adjustments.
7. Effective energy utilization.

### 3.02 FINAL CLEANING

A. General: General cleaning during construction is required by the General Conditions and included in Section 01500 - TEMPORARY FACILITIES.

B. Cleaning: Contractor shall employ experienced workers or professional cleaners for final cleaning. Contractor shall clean each surface or unit to the condition expected in a normal, commercial building cleaning and maintenance program. Contractor shall comply with manufacturer's instructions.

1. Complete the following cleaning operations before requesting inspection for Certification of Substantial Completion.
2. Remove labels that are not permanent labels.
3. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compound and other substances that are noticeable vision obscuring materials. Replace chipped or broken glass and other damaged transparent materials.
4. Clean exposed exterior and interior hard-surfaced finishes to a dust-free condition, free of stains, films and similar foreign substances. Restore reflective surfaces to

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their original reflective condition. Leave concrete floors broom clean. Vacuum carpeted surfaces.

5. Wipe surfaces of mechanical and electrical equipment. Remove excess lubrication and other substances. Clean plumbing fixtures to a sanitary condition. Clean light fixtures and lamps.
  6. Clean the site, including landscape development areas, of rubbish, litter and other foreign substances. Sweep paved areas broom clean; remove stains, spills and other foreign deposits. Rake grounds that are neither paved nor planted, to a smooth even-textured surface.
- C. Pest Control: Contractor shall engage an experienced exterminator to make a final inspection, and rid the Project of rodents, insects and other pests.
- D. Removal of Protection: Contractor shall remove temporary protection and facilities installed for protection of the Work during construction.
- E. Compliance: Contractor shall comply with regulations of authorities having jurisdiction and safety standards for cleaning. Contractor shall not burn waste materials. Contractor shall not bury debris or excess materials on the Owner's property. Contractor shall not discharge volatile, harmful or dangerous materials into drainage systems. Contractor shall remove waste materials from the site and dispose of in a lawful manner.
- F. Extra Materials: Where extra materials of value remaining after completion of associated Work have become the Owner's property, Contractor shall arrange for disposition of these materials as directed.

—END OF SECTION—

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## SECTION 02122

### MOBILIZATION AND DEMOBILIZATION

#### PART 1 -GENERAL

- 1.1 This section covers the requirements for mobilization and demobilization of all required equipment at the project site.

#### PART 2- PRODUCTS

##### 2.1 MOBILIZATION

Mobilization shall consist of the transporting, assembling, constructing, installing and making ready for use at the well site all equipment, machinery, structures, utilities and incidentals necessary to do the work covered by this contract.

##### 2.2 DEMOBILIZATION

Demobilization shall consist of the dismantling and removal from the project site all of the above-mentioned equipment, machinery, structures, utilities and incidentals not incorporated in or made a necessary part of the completed well.

#### PART 3- EXECUTION

##### 3.1 GUIDELINES

The Contractor shall clear and grade the site as shown in the construction documents prior to moving and setting up at the project site, including tree removal.

The Contractor shall be completely mobilized at the project site and begin work within 30 calendar days after he has been notified, in writing, to proceed under this contract. Any provision in the Standard Specifications to the contrary is hereby deleted.

If the Contractor utilizes private lands other than the well site and access road for mobilization purposes, the provisions of this section shall still apply, and the mobilization and demobilization work on said private lands shall also be in accordance with the agreement between the Contractor and the land owner.

When the project is completed the Contractor shall clean up the well site and shall be responsible for all grading work required to leave the site in a neat and orderly condition to the satisfaction of the Engineer. Payment for the clean-up work will not

Mobilization and Demobilization  
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be paid for separately but shall be included in the contract unit price for this item subject, however, to all provisions specified hereinabove.

### 3.2 MEASUREMENT

Measurement for payment of the work under this section of the specifications will be made as follows:

1. Half of the contract lump sum price for this item will be paid when all necessary equipment and supplies are present onsite and in the Engineer's opinion the Contractor has fully mobilized.
2. Half of the contract lump sum price for this item will be paid after all work has been completed and accepted by the Department and the project site cleaned to the satisfaction of the Engineer.

Should the Department terminate the contract before 50 feet of the pilot borehole has been acceptably drilled for reasons other than those specified in the Standard Specifications and in the Engineer's opinion the Contractor has fully mobilized at the well site, the half of the contract unit price for this item shall become due and payable subject, however, to all the provisions specified hereinabove. The other half of the contract unit price for this item shall also become due and payable after the above-mentioned termination of the contract, subject however, to all the provisions specified hereinabove.

### 3.3 PAYMENT

Mobilization and demobilization will be paid for at the applicable contract unit prices for Mobilization and Demobilization as the case may be, which prices shall be full compensation for all the work specified in this section and not to exceed 10% of the total bid excluding the price for this item.

END OF SECTION

Mobilization and Demobilization  
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## SECTION 02200

### SITE PREPARATION

#### PART 1 - GENERAL

##### 1.1 GENERAL REQUIREMENTS

Furnish all labor, materials, equipment and tools necessary to complete all clearing and grubbing of the entire construction area, accumulate and properly dispose of all debris and waste materials, and stake out the entire work area as indicated on the contract drawings and specified herein.

##### 1.2 EXISTING CONDITIONS

The Contractor shall visit the project site(s), examine the existing conditions and the extent of work involved for the completion of the project.

#### PART 2 - PRODUCTS

##### 2.1 MATERIALS

###### A. Weed Killer:

Trade Name	Manufacturer
Rad-E-Cate 25	Vineland Chemical Co. Vineland, New Jersey
Weed-B-Gone	Chevron Chemical Co. Ortho Division Richmond, California
Amitrol-7	Amehem Products, Inc. Fremont, California

#### PART 3 - EXECUTION

##### 3.1 GENERAL CONDITIONS

- A. The Contractor shall confine his work to the project site(s). Access to the site(s) shall be as directed by the Engineer. Any or all damages resulting from the Contractor's negligence shall be replaced, repaired or paid for by the Contractor for he shall relieve the State of all damages resulting therefrom.
- B. The Contractor shall protect from damage all surrounding existing conditions, grassing, landscaping, roadways, fences, structures. etc. that are to remain. Any damage shall be repaired and/or replaced by the Contractor to the satisfaction on the

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Engineer.

- C. Maintaining Traffic: The Contractor shall conduct his operations with minimum interference to streets, driveways, passageways, sidewalks, community functions, etc.
- D. Where necessary, the Contractor shall provide, erect and maintain lights, barriers, etc. as required by traffic and safety regulations.
- E. The Contractor shall fill holes, trenches, etc., left from the removal work with compact fill material as required and finished with a 6-inch layer of topsoil. Areas to be carefully tamped, hand raked to match surrounding grades and grassed to match existing.

### 3.2 PERMITS

The Contractor shall apply for and obtain the necessary permits prior to the commencement of work. The Contractor shall pay for all fees.

### 3.3 CLEARING AND GRUBBING

- A. The Contractor shall clear the site of all obstacles and obstructions not scheduled to remain, to include but not limited to tree limbs and stumps, the removal of which will be necessary for the proper reception, construction, execution and completion of other work included in this project.
- B. All clearing and grubbing shall be done in accordance with Section 201 of the "Standard Specifications For Public Works Construction", State of Hawaii, dated September 1986.
- C. The Contractor shall remove all required trees as noted in the plans within the graded areas and as required to perform grading work. Tree removal of stumps and roots shall be to a minimum of 12" below finish grades.

### 3.4 CONTRACT ZONE LIMITS

The Contract Zone Limits on the contract drawings only indicate in general the limits of work involved. However, the Contractor shall be required to perform any and all necessary work which may fall outside these demarcation lines. The Contractor shall also confine all of his construction activities within the Contract Zone Limits and not to spread his equipment indiscriminately about the site(s).

### 3.5 VERIFICATION OF EXISTING GRADES

Existing grades, inverts and improvements shall be verified by the Contractor before any clearing and grubbing operations shall commence. Any discrepancies shall be immediately brought to the attention of the Engineer and any changes made shall be in accordance with his instructions. Commencing with clearing and grubbing operations shall be construed to mean that the Contractor agrees that the existing

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grades, inverts and improvements are essentially correct as indicated. No extra compensation will be allowed to the Contractor if existing grades, inverts and improvements are in error after his verification thereof, or if he fails to report the discrepancies to the Engineer before proceeding with the work.

### 3.6 CLEAN-UP OF PREMISES

- A. Clean-up and remove all debris accumulated from construction operations from time to time and as directed by the Engineer. Upon completion of the construction work and before final acceptance of the contract, remove all debris, surplus material, equipment, etc., and leave the entire project site(s) raked clean and neat to the satisfaction of the Engineer.
- B. Displaced Material: Except where otherwise directed by the Engineer, all displaced materials having salvage value shall be carefully and neatly stacked or stored on the site where directed, and shall remain the property of the State. All materials having no salvage value, as determined by the Engineer, shall be completely removed and properly disposed of from the project site.

END OF SECTION

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## SECTION 02202

### STRUCTURAL EXCAVATION, BACKFILL AND COMPACTION

#### PART 1 – GENERAL

- 1.01 GENERAL CONDITIONS: The General Conditions and Special Provisions preceding these specifications shall govern this section of the work.
- 1.02 WORK INCLUDED: Furnish all labor, materials, tools, equipment and related items necessary for excavating and backfilling trench for water lines, drain lines, sewer lines, electrical units, and appurtenances in conformity with the dimensions, profiles, section and details shown on the plans and the Water System Standards of the Department of Water Supply, County of Hawaii, Station of Hawaii, 2002 and as supplemented and/or modified herein. The Contractor shall be solely responsible for the means, techniques, procedures, and sequences for dewatering and bracing and shoring the excavation.

1.03 RELATED WORK IN OTHER SECTIONS

Site Earthwork..... Section 02210  
Trench Excavation and Backfill ..... Section 02221

SUBSURFACE SOIL DATA: Subsurface soil investigations have been made at the Lalamilo 10 MG Reservoir project site by Geolabs, Inc. entitled “Geotechnical Engineering Exploration Lalamilo 10MG Reservoir, Waimea, Island of Hawaii” dated February 18, 2022. Test pit logs are shown in the soils report. A copy of the complete soils report is included as part of the bid documents.

#### PART 2 – PRODUCTS (NOT USED)

#### PART 3 – EXECUTION

3.01 EXCAVATION

- A. Excavation for structures shall be carried down to elevations required by the drawings and shall be graded level on unfilled, undisturbed, firm bearing soil. Soft spots shall be compacted to unyielding firmness if soil conditions are suitable and approve footing cuts may be made exact dimensions of the footing.
- B. If any conditions not described in the Contract Documents such as perched water, seepage, lava tubes or blisters of a potentially adverse nature, these conditions shall be immediately brought to the attention of the Geotechnical Engineer so supplemental recommendations can be made to address these conditions.

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- C. The Contractor is responsible for providing protection from erosion, ponding and storm water pollution. Construction Best Management Practice (BMP) shall be utilized for the duration of the project.

3.02 UNSUITABLE EXCAVATED MATERIAL

The Contractor shall remove from the site all unsuitable excavated material unless specified otherwise by the Engineer. The unsuitable material not containing organic material shall be hauled and placed in the excavation for coralline material where shown on the drawings. Unsuitable material containing organic material shall be disposed of off-site.

Removal, including hauling and disposal, of the unsuitable material will not be paid for directly, but shall be considered incidental to the project.

—END OF SECTION—

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SECTION 02210  
SITE EARTHWORK

PART 1 – GENERAL

1.1 GENERAL CONDITIONS

The General Conditions and Special Provisions preceding these specifications shall govern this section of the work.

1.2 WORK INCLUDED

Furnish all labor, materials, services, equipment and related items necessary to excavate, fill, remove, transport, stockpile, place and dispose of all materials within the limits of the project required to construct the site work improvements in accordance with these specifications, dimensions, sections and details shown on the plans, and the approval of the Engineer.

1.3 REFERENCES

- A. Work shall be governed by the Counties' "Standard Specifications for Public Works Construction" (Standard Specifications), dated 1986 as revised, except as amended in the plans and specifications here within. (Paragraphs concerning Measurement and Payment in the Sections are not applicable to this project).
- B. The Contractor is expected to examine the site and decide for himself the character of materials to be encountered.

1.4 PROTECTION

- A. The Contractor shall incorporate into his work schedule the Temporary Erosion Control Measures and the Permanent Erosion Control procedures indicated on the plans and as specified in the contract.
- B. Every effort shall be made by the Contractor to keep dust to a minimum. Spraying the ground with water or other means of control shall be used wherever possible. The Contractor shall have an adequate supply of water for moisture conditioning of fill material.
- C. Without limiting the generality or applicability of other indemnity provisions of the contract, the Contractor agrees that he shall indemnify and hold harmless the State from and against all suits, actions, claims, demands, damages, costs and expenses (including but not limited to attorney's fees) arising out of any damage to any property whatsoever or injury to any person whomsoever, in any way caused or contributed to by dust from the Contractor's operations.

Site Earthwork  
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- D. The Contractor shall be responsible for the protection of existing surface and subsurface utilities and poles within and abutting the project site, trench excavations and other work areas.
- E. All subgrades shall be kept moist until covered by subbase, base course, or concrete. All finished grades shall be kept moist until covered by landscaping or other permanent groundcover. Where shrinkage cracks are noted after compaction of the subgrade or finished grade, the subgrade or finished grade shall be rescarified, moisture-conditioned to above the optimum moisture content, and recompact to the specified requirement at no additional cost to the State. During construction, the Contractor shall properly grade and maintain all excavated surfaces to provide positive drainage and prevent ponding of water. In the event that ponding of water caused softening of the subgrades, the Contractor shall remove the soft soils and shall backfill the excavation with compacted fill at no additional cost to the State.

## 1.5 PERMITS

The Contractor shall obtain and pay for any required permits prior to the commencement of the work.

## PART 2 – PRODUCTS

### 2.1 MATERIALS

Fills, backfills and select borrow fills shall conform to the reference documents that will be made part of these contract documents.

## PART 3 – EXECUTION

### 3.1 GENERAL

- A. Site excavation, embankment and grading shall be performed in accordance with “Standard Specifications for Public Works Construction” (Standard Specifications), dated 1986 as revised, and as specified herein.
- B. The Engineer shall be notified by the Contractor after clearing and grubbing and before any fill is placed; and also at least two weeks in advance before grading operations are scheduled to begin. Further, the Contractor shall advise the Engineer of the proposed overall schedule for earthwork operations.
- C. All cuts and fills to be constructed shall be monitored by a licensed Geotechnical Engineer retained by the Contractor, who shall approve all site preparation, fill material, methods of placing and compaction and perform field density tests during the grading. Written approval shall be issued upon completion of cuts and fills. No deviation from these specifications shall be made except upon the written approval of the Engineer and/or other public agencies having jurisdiction.

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- D. The Engineer shall be notified at least five working days prior to start of grading. A pre-grading conference shall be held between the parties involved to discuss methods of operations, site problems and scheduling. Field density tests shall be taken by the Contractor's Geotechnical Engineer.
- E. The Contractor shall have a responsible field superintendent on the project in full charge of the work with authority to make decisions at all times. He shall cooperate with the Engineer in carrying out the work. Any instructions given to him by the Engineer shall be considered to have been given to the Contractor personally.
- F. No fill shall be placed, spread or rolled during unfavorable weather. When the work is interrupted by rain, operations shall not be resumed until field tests by the Engineer indicate that conditions will permit satisfactory results.
- G. If unforeseen or undetected soil conditions such as soft spots, existing utility trenches, structure foundations, voids or cavities, boulders, seepage water or expansive soil pockets, etc. are encountered, the Contractor at his sole expense shall make all necessary corrective measures in the field as such conditions are detected.

### 3.2 LAYING OUT

- A. The area shall be cleared of brush, weeds, vegetation, and debris. All of these materials shall be satisfactorily placed around the project site at no cost to the State.
- B. The laying-out of base lines, establishment of finish grades and staking out of the entire work and verification of finished grades of the subbase to the required tolerances shall be done by a registered Surveyor licensed in the State of Hawaii. The Contractor shall carefully preserve all data and all monuments set by the Surveyor and, if displaced or lost, immediately replace them to the acceptance of the Engineer at no additional cost to the State.
- C. Discrepancies: Should any discrepancies be discovered in the dimensions given in the plans, the Contractor shall immediately notify the Engineer before proceeding any further with the work, otherwise he will be held responsible for any costs involved in the correction of the construction placed due to such discrepancies.

### 3.3 SITE PREPARATION

- A. Prior to commencement of earthwork operations, all vegetation debris and other deleterious materials shall be removed from the site.
- B. Soft spots, loose areas or uncompacted fills shall be overexcavated to stiff or dense materials, and the resulting depression backfilled.

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#### 3.4 ONSITE FILL

- A. Onsite excavated material may be acceptable for reuse as backfill provided it conforms to the MATERIALS portion of this Section and accepted by the Geotechnical Engineer. Prior to reuse, all reused material shall be properly cleaned and prepared.

#### 3.5 EXCAVATIONS

- A. All excavation shall be made to the lines and grades as shown on the project plans. All excavation shall be inspected and accepted by the Geotechnical Engineer. Where conditions encountered require, the Geotechnical Engineer shall direct the necessary modifications to be made.

#### 3.6 GRASSING

- A. Sod, plant or hydromulch all slopes and exposed areas immediately after the grading work has been completed.

#### 3.7 DRAINAGE

- A. Care shall be exercised during grading so that areas involved will drain properly. Water shall be prevented from running over the slopes by the temporary berms or drainage swales.

#### 3.8 UNSUITABLE EXCAVATED MATERIAL

- A. The Contractor shall remove from the project site all unsuitable excavated material unless specified otherwise by the Engineer.
- B. Removal, including hauling and placement, of the unsuitable material will not be paid for directly, but shall be considered incidental to the project.

END OF SECTION

Site Earthwork  
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## SECTION 02215

### GEOTEXTILE FILTER FABRIC

#### PART 1 – GENERAL

- 1.01 GENERAL CONDITIONS: The General Conditions and Special Provisions preceding these specifications shall govern this section of the work.
- 1.02 WORK INCLUDED: Provide geotextile filter fabric as specified in the contract documents, as specified by the product manufacturer.

#### PART 2 – PRODUCTS

- 2.01 MATERIALS: Geotextile filter fabric shall be as specified below. Mirafi 170N or approved equal.

A. Mechanical Properties:

- |    |   |                     |
|----|---|---------------------|
| 1. | Grab Tensile Strength:<br>ASTM D 4632       |                     |
|    | Strength at Ultimate                        | 0.80 kN or 180 lbs  |
|    | Elongation at Ultimate                      | 50%                 |
| 2. | Mullen Burst Strength:<br>ASTM D 3786       | 2412 kPa or 350 psi |
| 3. | Trapezoidal Tear Strength:<br>ASTM D 4355   | 0.33 kN or 75 lbs   |
| 4. | Puncture Strength:<br>ASTM D 4833           | 0.50 kN or 105 lbs  |
| 5. | CBR Puncture Strength:<br>ASTM D 6241       | 2.0 kN or 450 lbs   |
| 6. | UV Resistance after 500 hrs:<br>ASTM D 4355 | 70% strength        |

B. Hydraulic Properties:

- |    |                                       |                          |
|----|---------------------------------------|--------------------------|
| 1. | Apparent Opening Size:<br>ASTM D 4751 | US Sieve 100 or 0.150 mm |
| 2. | Permittivity:<br>ASTM D 4491          | 1.2 sec <sup>1</sup>     |

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3. Flow Rate:  
ASTM D 4751 4277.7 l/min/m<sup>2</sup> or 105 gal/min/ft<sup>2</sup>

### PART 3 – EXECUTION

3.01 Shall be as specified to the product manufacturers specifications.

—END OF SECTION—

Geotextile Filter Fabric  
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Job No. G25CH17A  
Upolu Well Development, 0.5 MG Reservoir, and Transmission Main

## SECTION 02510 – HDPE WATER PIPE

### PART 1 – GENERAL

#### 1.01 DESCRIPTION

The work in this section consists of providing High Density Polyethylene (HDPE) pipe and fittings.

#### 1.02 QUALITY ASSURANCE

References, American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), Federal Specifications (FS), International Standards Organization (ISO), and manufacturer's printed recommendations.

#### 1.03 SUBMITTALS

Material list naming each product to be used identified by manufacturer and type number, in accordance with Section 01340 DRAWINGS TO BE FURNISHED BY THE CONTRACTOR.

#### 1.04 PRODUCT HANDLING

Handle pipe and fittings to insure delivery in a sound undamaged condition.

#### 1.05 JOB CONDITIONS

Do not lay pipe when trenches or weather conditions are not suitable for such work.

### PART 2 – PRODUCTS

#### 2.01 PIPE

- A. 2 Inches and Smaller Pipe shall be manufactured from a PE 3408 resin listed with the Plastic Pipe Institute (PPI) as TR-4. The resin material will meet the specifications of ASTM D3350-02 with a cell classification of PE:345464C. Pipe shall have a manufacturing standard of ASTM D2737 (CTS). Pipe shall be DR 9 (200psi WPR) unless otherwise specified on the plans. The pipe shall contain no recycled compounds except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. All pipes shall be suitable for use as pressure conduits, and per AWWA C901, have nominal burst values of three times the Working Pressure Rating (WPR) of the pipe. Pipe shall also have the following agency listing of NSF 61.
- B. 3 Inches and Larger - Pipe shall be manufactured from a PE 3408 resin listed with the Plastic Pipe Institute (PPI) as TR-4. The resin material will meet the specifications of ASTM D3350 with a cell classification of PE:345464C. Pipe shall have a manufacturing standard of ASTM

HDPE Water Pipe  
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F714. Pipe shall be DR 17 (100psi WPR) for pipe sizes up to 36" unless otherwise specified on the plans. The pipe shall contain no recycled compounds except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. All pipes shall be suitable for use as pressure conduits, listed as NSF 61, and per AWWA C906 Pressure Class (PC) 100 have a nominal burst value of three and one-half times the Working Pressure Rating (WPR) of the pipe. Peak flow water velocity of 5 ft/sec shall be used in the hydraulics engineering design.

## 2.02 FITTINGS

- A. Butt Fusion Fittings - Fittings shall be PE3408 HDPE, Cell Classification of 345464C as determined by ASTM D3350-02, and approved for AWWA use. Butt Fusion Fittings shall have a manufacturing standard of ASTM D3261. Molded & fabricated fittings shall have a pressure rating equal to the pipe unless otherwise specified in the plans. Fabricated fittings are to be manufactured using Data Loggers. Temperature, fusion pressure and a graphic representation of the fusion cycle shall be part of the quality control records. All fittings shall be suitable for use as pressure conduits, and per AWWA C906, have nominal burst values of three and one-half times the Working Pressure Rating (WPR) of the fitting.
- B. Electrofusion Fittings - Fittings shall be PE3408 HDPE, Cell Classification of 345464C as determined by ASTM D3350-02. Electrofusion Fittings shall have a manufacturing standard of ASTM F1055. Fittings shall have a pressure rating equal to the pipe unless otherwise specified on the plans. All electrofusion fittings shall be suitable for use as pressure conduits, and per AWWA C906, have nominal burst values of three and one-half times the Working Pressure Rating (WPR) of the fitting.
- C. Flanged and Mechanical Joint Adapters - Flanged and Mechanical Joint Adapters shall be PE 3408 HDPE, Cell Classification of 345464C as determined by ASTM D3350-02. Flanged and Mechanical Joint Adapters shall have a manufacturing standard of ASTM D3261. Fittings shall have a pressure rating equal to the pipe unless otherwise specified on the plans.

## PART 3 – EXECUTION

### 3.01 GENERAL

Pipe and Fittings: Size as indicated on the plans. Install as shown in accordance with manufacturer's recommendations.

### 3.02 HAULING, UNLOADING AND DISTRIBUTING PIPE

During loading, transportation and unloading, every precaution shall be taken to prevent injury to the pipe. No pipe shall be dropped from cars or trucks, or allowed to roll down slides without proper retaining ropes. During transportation each pipe shall rest on suitable

HDPE Water Pipe  
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pads, strips, skids or blocks securely wedged or tied in place. Any pipe damaged shall be replaced at no additional cost to the Department.

### 3.03 FUSION

- A. Sections of polyethylene pipe should be joined into continuous lengths on the jobsite above ground. The joining method shall be the butt fusion method and shall be performed in strict accordance with the pipe manufacturer's recommendations. The butt fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to, temperature requirements of 400 degrees Fahrenheit, alignment, and an interfacial fusion pressure of 75 PSI. The butt fusion joining will produce a joint weld strength equal to or greater than the tensile strength of the pipe itself. All welds will be made using a Data Logger to record temperature, fusion pressure, with a graphic representation of the fusion cycle shall be part of the Quality Control records.
- B. Sidewall fusions for connections to outlet piping shall be performed in accordance with HDPE pipe and fitting manufacturer's specifications. The heating irons used for sidewall fusion shall have an inside diameter equal to the outside diameter of the HDPE pipe being fused. The size of the heating iron shall be 1/4 inch larger than the size of the outlet branch being fused.
- C. Mechanical joining will be used where the butt fusion method can not be used. Mechanical joining will be accomplished by either using a HDPE flange adapter with a Ductile Iron back-up ring or HDPE Mechanical Joint adapter with a Ductile Iron back-up ring.
- D. Socket fusion, hot gas fusion, threading, solvents, and epoxies will not be used to join HDPE pipe.

### 3.04 INSTALLATION

- A. The installation, testing, disinfection and acceptance of water lines shall be governed by the DWS Standards and the Uniform Plumbing Code.
- B. The Contractor shall be responsible for precisely laying out the various utility lines shown on the contract plans as provided elsewhere in these specifications. The location shown on the contract plans of the various existing utility lines which the new lines are to cross over or under or connect to were determined on the basis of the best information available; however, no assurance can be provided that the actual locations will be precisely as shown on the contract plans.
- C. In performing all work, the Contractor shall exercise due care and caution necessary to avoid any damage to and impairment in the use of any existing utility lines. Any damage inflicted on existing lines resulting from the Contractor's operations shall be immediately repaired and restored as directed by the Project Manager at the Contractor's expense.

HDPE Water Pipe  
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- D. Connections to or the lowering or relocation of existing mains shall be done by the Contractor in accordance with the DWS Standards. The Contractor shall furnish all necessary pipe, fittings, appurtenances and other incidental materials.
- E. Trenching, pipe cushion and backfilling for the water main shall be in accordance with the DWS Standards.
- F. The Contractor shall coordinate the connection of the new water line with the Project Manager. The Contractor shall inform the Project Manager a minimum of one week prior to the date of the actual connection. The inverts shown on the plans are approximate only, and the Contractor shall adjust the slope of the new water line as necessary to construct a fully functional and acceptable system. The Contractor shall ensure that all piping, fittings, materials, tools, equipment and incidentals are at the site and ready for connection.

### 3.05 INSPECTION

Inspect the pipe for defects before installation and fusion. Defective, damaged or unsound pipe will be rejected.

### 3.06 TESTING

Pressure testing shall be conducted in accordance with ASTM F2164, Field Leak Testing of Polyethylene Pressure Piping Systems Using Hydrostatic Pressure. The HDPE pipe shall be filled with water, raised to test pressure and allowed to stabilize. The test pressure shall be 1.5 times the operating pressure at the lowest point in the system. In accordance with section 9.8, the pipe shall pass if the final pressure remains within 5% of the test pressure for 1 hour. For safety reasons, hydrostatic testing only will be used.

END OF SECTION

HDPE Water Pipe  
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## SECTION 02513

### ASPHALTIC CONCRETE PAVEMENT

#### PART 1 – GENERAL

##### 1.01 GENERAL REQUIREMENTS:

The Counties' STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION (Standard Specifications) dated September 1986 and STANDARD DETAILS FOR PUBLIC WORKS CONSTRUCTION dated September 1984 as revised, except as amended in the plans and/or specifications herewith. (Paragraphs concerning Measurements and Payments in the Sections are not applicable to this project).

##### 1.02 WORK SPECIFIED IN OTHER SECTIONS:

Excavation and fill are specified in Section 02210 – EARTHWORK.

##### 1.03 INSPECTION

All work for asphalt concrete pavements within Hawaii County easements and roadways shall be inspected and approved by the Department of Public Works, Hawaii County. The Contractor shall make arrangements directly with the County for inspection of the work.

##### 1.04 SUBMITTALS

The mix design for the asphalt concrete pavement.

#### PART 2 – PRODUCTS

##### 2.01 MATERIALS

Materials for roads and parking areas shall be constructed in accordance with the below-listed sections of the Counties' STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION dated September 1986, except as amended in the plans and/or specifications herewith.

Subgrade ..... Section 29

Select Borrow for Subbase Course ..... Section 30

Asphaltic Concrete Pavement  
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Aggregate Base Course ..... Section 31

Tack Coat for Pavement .....Section 33

Asphalt Concrete Pavement .....Section 34

### PART 3 – EXECUTION

#### 3.01 INSTALLATION

The subgrade shall be prepared and compacted in accordance with Section 29 of the Standard Specifications. Soil test shall be made at the subgrade level and the final payment structure verified or modified as necessary.

The subbase course and base course shall be constructed in accordance with Sections 30 and 31 of the Standard Specifications. Field density tests shall be made by the Soils Engineer to verify that the compaction obtained meets the specifications.

The asphalt concrete pavement shall be constructed in accordance with Section 34 of the Standard Specifications.

Any pavement not acceptable to the County or Owner shall be reconstructed at no additional cost to the Owner.

--END OF SECTION--

Asphaltic Concrete Pavement  
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Upolu Well Development, 0.5 MG Reservoir, and Transmission Main

## SECTION 02820

### FENCES

#### PART 1 - GENERAL

##### 1.1 GENERAL REQUIREMENTS

Furnish materials, labor and equipment necessary to install all cattle fences to the limits shown and as detailed on the plan and as specified herein. All material shall be new, specifically purchased for this project.

##### 1.2 SUBMITTALS

- A. Submit in accordance with Section 01300 – SUBMITTAL PROCEDURE.
- B. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, and schedule of components.
- C. Product Data: Submit data in the form of manufacturer's technical data, specifications, and installations for fence and barbed wire, fence posts, and accessories.
- D. Samples: Submit samples of fence fabric illustrating construction
- E. Manufacturer's Installation Instructions: Submit installation requirements.

##### 1.3 QUALITY ASSURANCE

- A. Supply material and provide installation in accordance with standard cattle fencing.
- B. Supply material in accordance with CLFMI – Product Manual (Chain Link Fence)
- C. Perform installation in accordance with ASTM F567 (Chain Link Fence)
- D. Maintain one copy of each document on site.

##### 1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing product specified in this section with minimum three (3) years of experience.
- B. Installer: Company specializing in performing work of this section with minimum three (3) years of experience.

##### 1.5 DELIVERY STORAGE AND HANDLING

- A. Deliver, store, protect and handle products with adequate protection against damage.

- B. Deliver fence fabric and accessories in packed cartons or firmly tied rolls.
- C. Identify each package with manufacturer's name.
- D. Store fence fabric and accessories in secure and dry place.

## 1.6 WARRANTY

Provide warranty for minimum five (5) years for cattle fence installation.

Provide warranty for minimum two (2) years for chain link fence installation.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Cattle Fence Fabric shall be steel, maximum 4-inch x 4-inch mesh, 14 ga, 36" high and hot-dipped galvanized. All fabric shall be free from barbs, icicles, or other hazardous projections resulting from galvanizing.
- B. Tie Wire shall be 12-gauge soft annealed galvanized steel wire as called for on the plans.
- C. Posts shall be green painted farm fence T-post from Lowe's or approved equal. 6' high except for corner post which shall be 7' high.
- D. Barbed wire shall be ASTM A121, using 12-1/2 gauge wire with 14 gauge barbs, round, four points, spaced at maximum of 4 inches on center, with minimum zinc coating of 0.80 ounces per square foot.
- E. Chain Link Fence Fabric shall be 2-inch mesh, 9 ga core, 8 ga finish galvanized and conform to ASTM A392, Class 1. The hot-dipped galvanized fabric shall contain not less than 1.2 ounces per sq. ft of uncoated wire surface as determined by stripping test ASTM A90 and under the PREECE Test (ASTM A239), shall withstand 6 or more 1-minute dips before reaching the end point. All fabric shall be free from barbs, icicles, or other hazardous projections resulting from galvanizing. Bottom selvages of chain link fabric shall be knuckled, top selvages shall be twisted.
- F. Tension Bar shall be 1/4-inch thick by 3/4-inch wide galvanized mild steel bar for attachment of a fabric to a terminal post.
- G. Brace Band shall be formed from galvanized steel bands at least 1/8-inch thick by 3/4-inch wide.
- H. Tension Band shall be formed from galvanized steel bands at least 12 gauge thick by 3/4-inch wide.
- I. Tension Rod shall be a 3/8-inch dia. galvanized mild steel rod threaded at one end and hooked 180 degrees at the other.

J. Fittings

1. Eye Top shall be of one-piece hot-dip galvanized cast iron construction and shall attach securely onto their respective posts.
2. Coupling for top rails shall be outside sleeve type, galvanized, at least 6-inches long and crimped at center.
3. Rail Ends shall be snug, one-piece fittings for top and brace rails with holes to receive 5/16-inch bolts for securing to rail end bands.
4. Double Rail End shall be similar to rail and except for an additional 1/2-inch hole to receive the hooked end of a tension rod.

K. Composition and Finish of Metal Parts: All metal parts and fittings, including tracks, gate hardware and frames, shall be of steel, malleable iron or wrought iron and shall be galvanized by the hot-dip process, after fabrication, in conformance with ASTM A153. The coating on all parts shall be continuous and smooth; that is, free from barbs, icicles or other projections. Bolts may be cadmium-plated in conformance with ASTM A165 instead.

L. Gate Hardware: Hinges shall be heavy duty offset type permitting 180-degree swing using double clamping method of attachment and manufactured or forged malleable iron. All hinges shall be of appropriate size and capacity for the particular gate being supported and/or operated.

M. Posts, Rails and Braces shall be of standard weight, hot-dipped galvanized, welded and seamless steel pipes conforming to ASTM A120.

N. Tension Wire shall be of 7-gauge coiled spring galvanized wire.

O. Concrete for post footings shall be Class "B" or Class 2500 as specified in Section 03300 CAST-IN-PLACE CONCRETE.

2.2 OTHER MATERIALS

All other materials not specifically listed herein-in, but required for the successful installation of the work included, are subject to acceptance.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.
- B. Beginning of work means installer accepted existing surface and substrate conditions.

### 3.2 INSTALLATION AND WORKMANSHIP

#### A. General

1. Cattle fencing shall be erected in strict conformance with the plans and these specifications. Posts shall be plumb and in line. No splicing of posts, rails or braces shall be accepted.
2. Install framework, fabric, accessories and gates in accordance with ASTM F567 and as noted on drawings.
3. Metal fencing and gates of the various types called for shall be erected in strict conformance with the plans and these specifications. The gates and hardware shall provide intended freedom of operation. Posts shall be plumb and in line. Welding shall be done in accordance with latest American Welding Society (AWS) standards. However, no splicing of posts, rails or braces shall be accepted. Where changes in line occur with an angle of deflection of 30 degrees or more, the change point will be considered a corner and a corner post shall be installed thereat. End, corner, and gate posts for fences with 5-foot and wider fabric shall be braced to the nearest line post with horizontal braces and tension rods. The horizontal braces shall be spaced midway between top rail and ground and securely fastened to posts as shown on plans. Where fencing is placed along a curve with radius of 50- feet, or less, horizontal braces (and tension rods) shall be installed between all posts in like manner. Pull posts, at maximum intervals of 300-feet, shall be braced and trusses in both directions as specified above.
4. Field Touch-Ups: Field welds shall be cleaned of flux and spatter and all damaged galvanizing removed, all hazardous projections ground off, properly prepared, and then heavily coated with self-curing inorganic zinc coating. Manufactured coatings shall be applied in strict accordance with manufacturer's printed specifications. Damage to existing painted surfaces shall be touched up.

#### B. Post and Rail Installation

1. Fence Posts, except as otherwise indicated or specified, shall be spaced not more than 10-feet apart. All high and low points along the corridor need to have a post to prevent the wire from "bellying".
2. Install posts with 6 inches maximum clear opening from end posts to buildings, fences and other structures, unless indicated otherwise.
3. T-posts will be driven to a minimum depth of twenty (20) inches; so that spade anchors are completely buried, using tubular post driver or driving cap in manner that will prevent damage to the posts.
4. Where posts are to be installed in solid rock, the spade anchors may be removed so that posts fit tightly in drilled hole.

5. All cuts will be sprayed with a cold galvanizing paint.
6. T-posts at low points will be driven deep enough to prevent them from being pulled up when tension is applied to the mesh wire. If a post does pull out, hanging rocks or other weights from the wire is not an acceptable means of re-anchoring the post.
7. On alignments running up or down slopes, posts should be installed perpendicular to the terrain.
8. Posts which are bent, split, mushroomed, cracked, twisted or have cracked, chipped, or scratched coatings will not be used.
9. Allow concrete to cure for minimum seven (7) days before installing fabric and other materials attached to posts.
10. Set intermediate and terminal posts plumb in concrete footings or concrete walls, as shown on drawings.
11. Line Post Footing Depth Below Finish Grade: Follow ASTM F567, unless indicated otherwise.
12. Corner and Terminal Post Footing Depth Below Finish Grade: Follow ASTM F567, unless indicated otherwise.
13. Top Rails shall pass through and bear firmly on base of eye tops, form a continuous brace from end to end of each stretch of fence, and be securely fastened to terminal posts with rail ends and brace bands. Couplings for the top rails shall be installed at intervals of 24-feet maximum.
14. Install center and bottom brace rail on corner gate leaves.
15. Brace each gate and corner post to adjacent line post with horizontal center brace rail and diagonal truss rods. Install brace rail one bay from end and gate posts.
16. Install top rail through the line post tops and splice with 6 inch long rail sleeves.
17. Install bottom rail through line post and splice with 6 inch long rail sleeves.

C. Fence Fabric Installation

1. Cattle Fabric shall be fastened on the side of the posts as designated and shall be mounted on the posts so that the bottom of the fabric will be no more above the finished grade than 6". High points of the ground shall be excavated as necessary. The fabric shall be stretched taut and securely fastened to the posts. The tie shall be installed around the frame member and a single strand of fence fabric. The two ends of the tie shall be twisted together three times forcing the tie to conform to the shape

of the frame member to make it difficult to insert an object between the tie and the frame member. The pointed ends of the tie shall lay in the direction of the travel of the fabric and tips shall be severed to reduce the hazard to personnel and make it difficult to untwist the tie. Between posts the top edge of the fabric shall be fastened to the top rail and the lower edge to the tension wire with tie wire of size and at spacing as called for on the plans.

D. Chain-Link Fabric Installation

2. Chain Link Fabric shall be fastened on the side of the posts as designated and shall be mounted on the posts so that the bottom of the fabric will be no more above the finished grade than called for on the plans. High points of the ground shall be excavated as necessary. The fabric shall be stretched taut and securely fastened to the posts. The tie shall be installed around the frame member and a single strand of fence fabric. The two ends of the tie shall be twisted together three times forcing the tie to conform to the shape of the frame member to make it difficult to insert an object between the tie and the frame member. The pointed ends of the tie shall lay in the direction of the travel of the fabric and tips shall be severed to reduce the hazard to personnel and make it difficult to untwist the tie. Between posts the top edge of the fabric shall be fastened to the top rail and the lower edge to the tension wire with tie wire of size and at spacing as called for on the plans. Tension wire shall be stretched tight and shall be installed in a straight line between posts. Tension bars extending the full height of the fence and tension bar bands shall be used for fastening fabric to end, corner, pull and gate posts. Bolted tension bar bands shall be placed at top and bottom of the tension bars and spaced at 12-inch intervals. Fastenings to line posts shall be made with tie wire of size and at spacing as called for on the plans.
3. Do not stretch fabric until grout for posts has cured for 14 days.
4. Stretch fabric between terminal post or at intervals of 100 feet maximum, whichever is less.
5. Fasten fabric to top, intermediate and bottom rails, line posts, truss rods, stretcher bars and with tie wire at maximum 15 inches on centers, unless shown otherwise.
6. Attach fabric to end and corner posts with stretcher bars and stretcher bar clips.

E. Barbed Wire Installation

1. Barbed wire shall be installed 2" from the top of post.
2. Stretch strands to remove sag and anchor firmly to post.

3.3 ERECTION TOLERANCES

- A. Maximum Variation from Plumb: 1/4 inch
- B. Maximum Offset from Indicated Position: 1 inch

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C. Maximum Distance as noted on plans: 6 inches

- F. Gates shall be of size specified in plans. The corners of gate frames shall be fastened together and reinforced with malleable iron fittings or by welding as approved. Welds shall all be ground smooth. Where sizes permit, frames shall be galvanized after fabrication, otherwise all welds shall be finished as specified for touching up abrasions and field welds. Walk gate frames for 6-foot high fences shall be cross-trussed with tension rods welded to frame at hooked end. Fabric specified for the fence shall be attached to the sides of the gate frame with full-height tension bars and tension bar bands at top, bottom and 12-inches o.c. along tension bars with 9-gauge tie wires shall be placed along the top and bottom of the gate at corners and 6-inches o.c. in between. The gates shall be hung by at least two hinges. For walk gates, a forked latch may be provided. Catch for the drop rod shall be galvanized pipe and set in concrete. Gate hold-backs shall be positioned to secure and support the free end of the gate in full open position and/or as shall be accessible from both sides of the gates.

### 3.4 ERECTION TOLERANCES

- A. Maximum Variation from Plumb: 1/4 inch
- B. Maximum Offset from Indicated Position: 1 inch
- C. Maximum Distance from Property Line: 6 inches

### 3.4 ADJUSTING

Adjust gates for smooth and balanced operation.

### 3.5 FINAL CLEAN-UP

All exposed metal surfaces shall be clean and free of cement. All surplus earth resulting from metal fencing work that is not used in the grading work shall be cleaned up and disposed of off-site. All debris resulting from work of this section shall be removed from the site.

END OF SECTION

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## SECTION 03200

### CONCRETE REINFORCING

#### PART 1 – GENERAL

##### 1.1 GENERAL REQUIREMENTS

- A. DESCRIPTION. This item of work consists of furnishing of labor, tools, equipment, and materials necessary to complete this item of work, in place complete, as shown on the plans and as specified in DIVISION 300 - CONSTRUCTION, Section 303.04 REINFORCING STEEL, and Section 303.05 WELDED WIRE FABRIC of the Water System Standards, 2002, and as amended hereinafter as they apply to this project.

##### 1.2 SUBMITTALS

- A. The Contractor shall furnish shop bending diagrams, placing lists, and drawings of all reinforcement steel before fabrication.
- B. Details of reinforcement steel for fabrication and erection shall conform to ACI 315 and the requirements indicated. The shop bending diagrams shall show the actual lengths of bars, to the nearest inch, measured to the intersection of the extensions (tangents for bars of circular cross section) of the outside surface. The shop drawings shall include bar placement diagrams which clearly indicate the dimensions of each bar splice.
- C. Where mechanical couplers are required or permitted to be used to splice reinforcement steel, the Contractor shall submit manufacturer's literature including instructions and recommendations for installation for each type of coupler used; certified test reports which verify the load capacity of each type and size of coupler used; and shop drawings which show the location of each coupler with details of how they are to be installed in the formwork.
- D. If reinforcement steel is spliced by welding at any location, the Contractor shall submit mill test reports which shall include the information necessary to determine if the carbon equivalent is as specified in AWS D1.4. The Contractor shall submit a written welding procedure for each type of weld for each size of bar which is to be spliced by welding; a mere statement that AWS procedures will be followed will not be acceptable.

#### PART 2 – MATERIALS

##### 2.1 MATERIALS

- A. Reinforcing steel shall conform to ASTM A615, Grade 60, typical.

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- B. All welded reinforcement, specifically detailed or otherwise indicated, shall be low-alloy grade 60 deformed bars conforming to the requirements of ASTM A706.
- C. Spiral reinforcement shall be cold-drawn steel wire conforming to the requirements of ASTM A82.
- D. Tie wire shall be Annealed Steel, 16 gauge minimum.
- E. The use of re-rolled rail steel or cold twisted bars is not permitted.
- F. Mechanical Couplers
  - 1. Mechanical couplers shall be provided where indicated and where approved by the Engineer. The couplers shall develop a tensile strength that exceeds 125 percent of the yield strength of the reinforcement bars being spliced at each splice.
  - 2. Where the type of coupler used is composed of more than one component, all components required for a complete splice shall be supplied.
  - 3. The reinforcement steel and coupler used shall be compatible for obtaining the required strength of the connection. Straight threaded type couplers shall require the use of the next larger size reinforcing bar or shall be used with reinforcing bars with specially forged ends which provide upset threads which do not decrease the basic cross section of the bar.

## PART 3 – EXECUTION

### 3.1 GENERAL

- A. All reinforcement steel, welded wire fabric, couplers, and other appurtenances shall be fabricated, and placed in accordance with the requirements of the ACI 318 and the supplementary requirements indicated herein.
- B. Fabrication and Delivery
  - 1. The Contractor shall conform to CRSI MSP, Chapters 6 and 7, except as otherwise indicated or specified. The Contractor shall bundle reinforcement and tag with suitable identification to facilitate sorting and placing, and transport and store at site so as not to damage material. The Contractor shall keep a sufficient supply of tested, approved, and proper reinforcement at site to avoid delays.
  - 2. Bending and Forming: The Contractor shall bend bars of indicated size and accurately form in accordance with the requirements of ACI 315 and ACI 318 to shapes and lengths indicated on drawings and required by methods not injurious to materials. The Contractor shall not heat reinforcement for bending. Bars with kinks or bends not scheduled will be rejected.

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3. Fabricating tolerance: All fabrication of reinforcing bars shall meet the requirements of ACI 117.

#### C. Placing

1. Reinforcement steel shall be accurately positioned and shall be supported and wired together to prevent displacement, using annealed iron wire ties or suitable clips at intersections. All reinforcement steel shall be supported by concrete, plastic or metal supports, spacers or metal hangers which are strong and rigid enough to prevent any displacement of the reinforcement steel. Where concrete is to be placed on the ground, supporting concrete blocks (or dobies) shall be used, in sufficient numbers to support the bars without settlement, but in no case shall such support be continuous. All concrete blocks used to support reinforcement steel shall be tied to the steel with wire ties which are embedded in the blocks. For concrete over formwork, the Contractor shall furnish concrete, metal, plastic, or other acceptable bar chairs and spacers.
2. Limitations on the use of bar support materials shall be as follows:
  - a. Concrete Dobies: Permitted at all locations except where architectural finish is required.
  - b. Wire Bar Supports: Permitted only at slabs over dry areas, interior dry wall surfaces, and exterior wall surfaces.
  - c. Plastic Bar Supports: Permitted at all locations except on grade.
3. Tie wires shall be bent away from the forms in order to provide the specified concrete coverage.
4. Bars additional to those shown which may be found necessary or desirable by the Contractor for the purpose of securing reinforcement in position shall be provided by the Contractor at no additional cost to the owner.
5. Unless otherwise specified, reinforcement placing tolerances shall be within the limits specified in Section 7.5 of ACI 318.
6. Bars may be moved as necessary to avoid interference with other reinforcement steel, conduits, or embedded items. If bars are moved more than one bar diameter, or enough to exceed the above tolerances, the resulting arrangement of bars shall be subject to the approval of the Engineer.
7. Accessories supporting reinforcing bars shall be spaced such that there is no deflection of the accessory from the weight of the supported bars. When used to space the reinforcing bars from wall forms, the forms and bars shall be located so that there is no deflection of the accessory when the forms are tightened into position.

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### 3.2 MINIMUM OVERLAP

- A. Minimum overlap for lapped splices shall be 40 bar diameters, but not less than 2'-0". Splices shall be staggered at least 24 inches.

### 3.3 SPLICES

- A. Splicing shall be in accordance with ACI-318, unless otherwise noted on Drawings.
- B. Vertical Bars. Except as specifically detailed or otherwise indicated, splicing of vertical bars in concrete is not permitted, except at the indicated or approved horizontal construction joints or as otherwise specifically detailed.
- C. Horizontal Bars. Except as specifically detailed or otherwise indicated, splicing of horizontal bars in concrete is not permitted.
- D. Mechanical Couplers. Only allowed with prior written approval by the Engineer. Follow manufacturer's requirements for installation.
- E. Welded splices shall be provided where indicated and where approved by the Engineer. All welded splices of reinforcement steel shall develop a tensile strength which exceeds 125 percent of the minimum yield of the reinforcing bars.

### PART 4 – PAYMENT

No separate payment for will be made; compensation for such work shall be deemed to be included in the Lump Sum Bid for the item of which it is a part.

END OF SECTION

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## SECTION 03210

### EARTHQUAKE CABLES

#### PART 1 – GENERAL

##### 1.1 GENERAL REQUIREMENTS

- A. Description. Furnish of all labor, materials, tools and equipment necessary to complete the tank earthquake cables work.

##### 1.2 SUBMITTALS

- A. The Contractor shall submit fabrication drawings specifying the quantity, location and details for the Engineer's approval before the earthquake cables are fabricated.

#### PART 2 – MATERIALS

##### 2.1 EARTHQUAKE CABLE STRANDS:

- A. Where specified on the Drawings, earthquake cables consisting of 7-wire galvanized strands shall meet the minimum physical and strength requirements listed here.

<u>Item</u>	<u>Specification</u>
1. Nominal strand diameter:	1/2"
2. Nominal area after galv.:	0.153 in <sup>2</sup>
3. Nominal weight/1000 LF:	541 lbs.
4. Pitch (Strand diameters):	12-16
5. Tensile strength (min.):	38,200 lbs.
6. Yield strength @ 1% extension (min):	28,500 lbs.
7. Elongation in 24" at fracture (min.):	4.5%
8. Weight of zinc coating (min.):	0.85 oz./ft. <sup>2</sup>

- B. The seismic cables shall be installed to connect wall to wall footing.
- C. The strands shall be hot-dipped galvanized before stranding with a minimum zinc coating of 0.85 oz./ft<sup>2</sup>.
- D. Galvanized strands for earthquake cables shall meet the quantity, length and spacing specified on the Drawings.

##### 2.2 CELL NEOPRENE SEISMIC CABLE SLEEVES:

- A. Neoprene sleeves for seismic cables, which encase the galvanized strands, shall conform to the minimum dimensions shown on the Drawings to allow unrestrained

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flexing of the strands inside the sleeves under the maximum projected radial wall movements.

- B. The material shall be medium grade closed cell neoprene conforming to 2A3 of ASTM D 1056-85 and as further specified here in and on the Drawings.

- |                                 |   |
|---------------------------------|---|
| 1. Compression deflection:      | 9-13 PSI  |
| 2. Density:                     | 18-28 PCF   |
| 3. Water absorption by weight:  | 0.5 lbs/ft <sup>2</sup>                                   |
| 4. Temperature range:           |   |
| Low (flex without cracking):    | -30°F   |
| High continuous:                | 150°F   |
| High intermittent:              | 200°F   |
| 5. Heat aging (7 days @ 158°F): | 5% lineal shrinkage (max.)                                |
| 6. Tensile strength:            | 115 PSI min.  |
| 7. Elongation:                  | 170% min.   |
| 8. Resilience:                  | 20% 40% (baysore % rebound average 1/2" thickness @ 72°F) |

- C. CYPRESS SPONGE 431N or 423N, or approved equal, are acceptable materials.

## 2.3 MILD STEEL REINFORCING BARS

- A. The mild steel reinforcing bars for the support of the earthquake cable anchors shall conform to the requirements of Section 03300, REINFORCING STEEL and as amended herein these technical specifications as they apply to this project.

## PART 3 – EXECUTION

### 3.1 EARTHQUAKE CABLE INSTALLATION

- A. Cable sets shall be installed equally spaced and in equal number in each quadrant of the reservoir wall. The spacing shown on the Drawings is only approximate and the number of cable sets specified is the governing criteria for placement.
- B. Where necessary, the strands shall be pre-bent before placing into wall and wall footing forms, as called for on the Drawings.
- C. The strands shall be separated and tied to circumferential wall reinforcing as required and shown on the Drawings.
- D. In the footing, the strands shall be fanned out and tied to the top of the radial bars at the bottom of the footing.

#### PART 4 – PAYMENT

No separate payment for will be made; compensation for such work shall be deemed to be included in the Lump Sum Bid for the item of which it is a part.

END OF SECTION

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## SECTION 03300

### CAST-IN-PLACE CONCRETE

#### PART 1 – GENERAL

##### 1.1 GENERAL REQUIREMENTS

- A. Description. Furnish all materials, labor and equipment required to accomplish all concrete work specifically for the concrete reservoir tank, as shown on the plans and as specified in DIVISION 300 - CONSTRUCTION, Section 303.03 CONCRETE WORK, of the Water System Standards, 2002, and as amended hereinafter as they apply to this project.

##### 1.2 QUALITY ASSURANCE

- A. Installer Qualifications: Due to the nature of the project, it is the intent of these Specifications to obtain a first-class product with emphasis on overall safety, quality and quality control, both during and after the construction process.
1. The qualified Tank Contractor shall have successfully constructed at least one (1) concrete tank located within the United States with qualified personnel employed by the Tank Contractor during the last four (4) years. In order to meet the experience requirements, the tanks shall be a circular cast-in-place or post-tensioned concrete reservoir for water that has a volume at least equal to the specified tank.
  2. The proposed Tank Contractor or Sub-Contractor shall employ personnel with responsible experience in construction of potable water tanks. The qualified Tank Contractor shall submit with his bid, the documented tank experience specified in item A.1. above and the resume of the proposed qualified personnel who will be on the project site in responsible charge, full-time, during all tank concrete construction activities for the full duration of the tank structure construction.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Testing Agency Qualifications: An independent agency, qualified according to ASTM C 1077 and ASTM E 329 for 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.

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2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."
- F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
  1. ACI 301, "Specifications for Structural Concrete,"
  2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- G. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

### 1.3 SUBMITTALS:

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
  1. Mix design shall list quantities to be used for a cubic yard of concrete. List all admixtures and proposed quantity to be used for each admixture. Specify range of slump and water-cement ratio. List sources of aggregates to be used and provide sieve analysis of each aggregate demonstrating compliance with Water System Standards gradations listed in Table 300-7 and 300-8.
- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- D. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.
  1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.

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2. All false work and forming requirements for roof support systems must be designed by an engineer registered in the State of Hawaii. The drawings, with supporting calculations, must each be signed and sealed by the engineer. No work shall be started until the roof support system and form design has been submitted. The false work design engineer must visit the site and approve the erection of all shoring prior to the placement of any concrete.
- E. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
1. Location of construction joints is subject to approval of the Engineer.
- F. Qualification Data: For Installer, manufacturer, and testing agency.
- G. Welding certificates
- H. Material Certificates: For each of the following, signed by manufacturers:
1. Cementitious materials.
  2. Admixtures.
  3. Form materials and form-release agents.
  4. Steel reinforcement and accessories.
  5. Curing compounds.
  6. Bonding agents.
  7. Adhesives.
  8. Vapor retarders.
  9. Semirigid joint filler.
  10. Joint-filler strips.
  11. Repair materials.
- I. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
1. Aggregates.

#### 1.4 DELIVERY, HANDLING, STORAGE

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
- B. Cement and aggregates shall be stored in a manner to prevent deterioration or the intrusion of foreign matter. Any material which has deteriorated or that has been damaged shall not be used for concrete and shall be promptly removed from the batching site.

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## PART 2 – MATERIALS

### 2.1 CEMENT, WATER & AGGREGATES

- A. General: Materials shall be in conformance with County of Hawaii, Standard Specifications for Public Works Construction, September 1986, Section 39.
- B. Portland Cement: ASTM C 150, Type I or Type II.
- 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 3/8 inch).
- D. 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.

### 2.2 ADMIXTURES

#### A. Retarding Densifiers

- 1. All 'DWS 4000' concrete used for wall construction, shall also contain DARATARD-17, as manufactured by Grace Const. Products, Cambridge, MA or MBL-82, as manufactured by Master Builders, Cleveland OH in the amounts recommended by the additive manufacturer whenever the air temperature during the pour exceeds 85° F.
- 2. To be considered as equal, any alternate product offered for consideration shall contain no calcium chloride, and shall be compatible with air-entrained cements and air-entraining admixtures conforming to the applicable ASTM, AASHTO, ANSI and Federal specifications.
- 3. Contractor shall certify that admixtures do not contain calcium chlorides or other corrosive materials.

#### B. Air-Entraining Agents

- 1. Unless specifically required by the Department of Land and Natural Resources, 'DWS 4000' concrete shall not be air-entrained. Unless otherwise specified, all other concrete may be air-entrained at the option of the Contractor.
- 2. Air-entraining agents shall meet ASTM C-260, ASTM C-233 and ASTM C-457.

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3. The maximum total volumetric air content of the concrete before placement shall be 6 percent plus or minus one percent as determined by ASTM C-173 or ASTM C-231.
4. Subject to these Specifications, consideration will be given to the following products: PROTEX “AES”, GRACE “DAREX AEA”, MASTER BUILDERS “MB-AE10”, OR SIKA CHEMICAL “AER”.

#### C. Water-Reducing Admixtures

1. In addition to air-entrainment, approved water reducing additives, which do not affect the ultimate performance of any steel in any way, may be added to maintain the maximum water content below that specified herein. Water reducing additives shall conform to ASTM C494, Type A.
2. The use of water reducing additives shall not permit a reduction in the minimum specified cement content or in the specified amount of air-entrainment.
3. Admixtures shall contain no calcium chloride, tri-ethanol amine or fly ash. All admixtures shall be from the same manufacturer.
4. Superplasticizers, if allowed by the Engineer, shall conform to ASTM C494, Type F or G, batch plant added using second or third generation only.

#### D. Shrinkage-Reducing Admixture

1. Shrinkage reducing admixture shall not contain any expansive material, but reduces material shrinkage by chemical action to reduce the surface tension of water. The admixture shall provide a minimum 50% reduction in the ultimate shrinkage at the dosage proposed.
2. Subject to these Specifications, consideration will be given to the following products: BASF “TETRAGUARD AS 20”, GRACE “ELIPSE PLUS”, or approved equal.

E. Crystalline Waterproofing Admixture: Admixture shall be designed to be added during concrete batching, the product reacts with moisture in fresh concrete and by-products of cement hydration to cause a catalytic reaction that generates a non-soluble crystalline formation throughout the pores and capillary tracts of the concrete permanently sealing the concrete.

### 2.3 CONCRETE CLASSES

- A. DWS 4000 – Reservoir wall, columns, roof slab, floor slab and foundation, pipe jackets under floor slabs and for items specifically noted on Drawings. The maximum water-cement ratio shall be 0.42. All concrete used in this class concrete shall include a crystalline waterproofing admixture.

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- B. DWS 3500 – Pipe jackets, and all building concrete, and for items specifically noted on Drawings. The maximum water-cement ratio shall be 0.46.
- C. DWS 2500 - All other concrete where strength is not indicated or shown, it shall be minimum 3,000 psi at 28 days.

## 2.4 EPOXY ADHESIVE

- A. Epoxy Adhesive shall be two-component, injectable, meeting the requirements of ASTM C881, Type IV, Grade 3. The adhesive product shall have a current ICBO or ICC ES Report permitting the use of the product in uncracked and cracked hard rock concrete with reinforcing steel dowels, such as Hilti 'HIT-RE 500-SD Injectable Mortar' or Simpson 'SET-XP Adhesive' or approved equal.

## PART 3 – EXECUTION

### 3.1 PROPORTIONING

- A. In addition to the requirements for “Proportioning Concrete Mix” specified in Section 303.03.C of the Water Systems Standards, the concrete mix design for elements of the concrete reservoir shall have a maximum water-cement ratio as stated in Section 2.3.
- B. The contractor has the option of including a shrinkage-reducing admixture to the reservoir concrete mix design in order to reduce the possibility of shrinkage cracks forming in reservoir concrete, however it is the responsibility of the contractor to verify admixtures used are compatible and will not result in undesirable properties in the concrete. Trial batches will be required to assure compatibility if manufacturers will not provide written confirmation of admixture compatibility.

### 3.2 HOT WEATHER CONCRETING

#### A. General

1. Description: Hot weather is defined as any combination of high air temperature, low relative humidity and wind velocity that results in a rate of evaporation of 0.2 pounds per square foot per hour based upon the evaporation rate determined by Figure 2.1.5 in ACI 305. During hot weather, any or all of the methods specified herein for temperature control of concrete shall be used as required to maintain the concrete temperature below the limits specified.
2. Shop Drawings: Not less than 30 days prior to expected placement of concrete under hot weather conditions, a complete procedure shall be submitted for review covering the aspects of protection of concrete and its ingredients from the detrimental effects of hot weather. Concrete placement during hot weather shall not commence prior to the return of the procedure marked "Reviewed".

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3. Product Delivery, Handling and Storage

- a. Aggregate piles, cement bins and batch plant bins shall be shaded from the direct rays of the sun.
  - b. Aggregate piles shall be cooled by wetting and evaporation. Aggregate wetting shall be performed in such a manner that it will not cause wide variations in moisture content impairing slump uniformity.
4. General Practices and Measures; The following list of practices and measures, as described in ACI 305, may be used to reduce or avoid the potential problems of hot weather concreting:
- a. Use concrete materials and proportions with satisfactory records in field use under hot weather conditions.
  - b. Use cool concrete.
  - c. Use a concrete consistency that permits rapid placement and effective consolidation.
  - d. Transport, place, consolidate, and finish the concrete with least delay.
  - e. Plan the job to avoid adverse exposure of the concrete to the environment; schedule placing operations during times of the day or night when weather conditions are favorable.
  - f. Protect the concrete against moisture loss at all times during placing and during its curing period.

B. Batching and Mixing

- 1. Concrete mix water shall be refrigerated or up to 100 percent of the water requirement may be ice added to the concrete mix. Ice, when introduced into the mixer, shall be in such form that it will completely melt and dispersed into the mix at the completion of the mixing time. The mixing time shall be held to the minimum practicable consistent with producing concrete meeting the specified requirements
- 2. All methods and equipment for cooling water and aggregate shall be subject to the approval of the Engineer and shall conform to ACI 305.

- C. Concrete Temperature: The temperature of concrete, as delivered at the time and location of placement, shall not exceed 100°F under any conditions. The temperature of concrete as delivered at the time and location of placement under the following combined ambient conditions, except concrete that will be deposited within wall or column forms, shall not exceed the following temperatures:

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Relative Humidity less than %	Ambient Temperature greater than °F	Maximum Concrete Temperature, °F
80	90	100
70	90	95
60	90	90
50	90	85
40	90	80
30	80	75
20	75	70

- D. Delivery: Concrete shall be placed in the Construction within 90 minutes after the completion of mixing.
- E. Preparation for Placing: Elevated forms and reinforcing steel for beams and slab members shall be cooled by fog spraying and evaporation immediately prior to placing concrete. Forms shall be free of standing water when concrete is placed herein.
- F. Placing: Concrete shall be placed in shallower layers than under normal weather conditions, if necessary, to assure coverage of the previous layer while it is still in plastic state and will respond readily to vibration.
- G. Finishing: Fog spray shall be used during finishing operations whenever necessary to avoid surface plastic shrinkage cracking. Fog spray shall also be used after finishing and before the specified curing is commenced to avoid surface plastic shrinkage cracking.
- H. Protection and Curing: Forms shall be kept covered and continuously moist. Once forms are loosened and during form removal, concrete surfaces shall be protected from drying and shall be kept continuously wet by fog spraying or other approved means.

### 3.3 FIELD TESTING

- A. Replace the third paragraph in Section 303.03.L, "Field Tests of Concrete" of the WSS with the following:

Five-cylinder samples shall be taken for each class of concrete poured each day and for every 50 cubic yards of each class or fraction thereof. Two (2) cylinders shall be tested at age of seven (7) days and twenty-eight (28) days in accordance with ASTM C39, "Standard Method of Test for Compressive Strength of Cylindrical Concrete Specimens". The last sample shall be held in reserve for use to verify suspect test results or a spoiled test sample.

- B. Slump tests shall be conducted on each ready-mix concrete truck discharging on-site for project site.

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### 3.4 FORM WORK

A. General. Forms shall be so constructed that they can be removed without hammering on, or prying against, the concrete and shall be removed in such a manner as to prevent damage to the concrete and to insure the complete safety of all parts of the structure. Forms previously used shall be thoroughly cleaned of all dirt, mortar and foreign matter before being reused.

#### B. Reservoir Form Work

1. All vertical wall and column footing sides shall be formed by methods acceptable to the Manager and the design engineer and to the correct elevations and location shown on the Drawings.
2. The wall form design shall be such that wall sections can be poured for the full wall length, or in vertical wall sections, without causing snapping of form ties which shall be of sufficient strength and number to prevent spreading of the forms during the placement of concrete and which shall permit ready removal of the forms without spalling or damaging the concrete.
3. Taper ties with plastic or rubber plugs of an approved and proven design may also be used for form ties. The plugs must be driven into the hole with a steel rod, placed in a cylindrical recess made therefore in the plug. At no time shall plugs be driven on the flat area outside the cylindrical recess. Plugs shall be A-58 SURE PLUG as manufactured by DAYTON SUPERIOR, Miamisburg, OH (phone: (800) 745-3700, [www.daytonsuperior.com](http://www.daytonsuperior.com)) or approved equal.
4. The BURKE, ECONOMY, SYMONS, ALUMA, and regular plywood forms may be used for forming of circular walls, as long as there are no straight sections longer than 36 inches at any place around the outside circumference of such walls.
5. The height of such wall panel forms shall not exceed 8 feet unless built-in pouring openings are incorporated in such wall panels. In this case, pouring of walls shall be done only through pouring openings on one of the wall sides, and may not be pumped or poured from the top using "elephant trunks" or tremies.
6. The pour openings shall be no smaller than 1.5-foot square, and spacing either vertically or horizontally no more than 8 feet. The bottom row of opening shall be no higher than 4 feet from the bottom of the form.
7. If pour windows are not provided, one side of the wall forms shall be no higher than eight (8) feet when the concrete placement begins and the wall forms may be installed in place as the pour progresses. The top of the form shall not be put in place until the height from the concrete surface to the top of the newly-placed form does not exceed nine (9) feet.

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8. Forms and falsework supports for the roof shall be sufficiently rigid and strong to support the wet concrete and the workers and equipment necessary for its placement without appreciable deflections. A minimum of 40 PSF for live-load shall be allowed in the falsework design.
9. The Contractor shall provide either wedges under timber posts, screw jacks under shoring, or other means to adjust the forms and relieve the load.
10. Unless the level of roof screeds remains unaffected by the deflection of roof-forms, an upward camber, where necessary in the opinion of the Engineer, shall be provided to all form areas which will deflect under the concrete load.
11. The Contractor shall determine if additional camber is required for the roof slab form to permit concrete and steel to act efficiently without development of deflection cracks.

#### C. Form Work Tolerances

1. Wall form sills shall be used to contain or hold down neoprene pads and facilitate proper alignment of forms. The maximum permissible variation in the horizontal and vertical location of the waterstops, neoprene pads and seismic cables (if required) is plus or minus 1/4 of an inch.
2. The maximum permissible variation in tank radius, as measured from the center of the tank to the inside wall surface at the bottom, is plus or minus 3/8 of an inch.
3. Out-of-round tolerance: 3/4" in 50 feet, 3/8" in 10 feet and 3/16" in 2 feet from the true curvature specified at any point on the wall.
4. The maximum permissible variation in the vertical alignment, from the bottom to the top of the wall, in plus or minus 3/8 of an inch.
5. The permitted tolerance of the average wall thickness for poured walls shall not vary more than 1/8-inch either way. All transitions from plus to minus shall be more gradual, even and smooth, and without abrupt changes in the surfaces.
6. Unless stated otherwise on the Drawings, the permissible tolerance at any point for flat roof form-surfaces shall not exceed plus or minus 1/4 inch from the specified elevation or thickness. The finished roof surface shall be capable of draining completely. Contractor shall camber or provide necessary forming supports to prevent low spots and to insure drainage. If low spots should occur, Contractor shall submit a corrective procedure to the Engineer for approval.
7. Slab screeds and bulkheads shall be set to specified alignment and elevations permitting a maximum tolerance of 1/4 inch plus or minus.

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8. Any transition between high and low points of the finished roof slab shall be gradual, smooth and even, and shall be to the satisfaction of the Engineer.
9. Adequate time and cooperation shall be provided to the Department of Land and Natural Resources Construction Inspector and design engineer to verify the compliance of these requirements prior to closing up the forms or pouring concrete.

### 3.5 FORM WORK REMOVAL

The following shall replace the times stated in table on WSS Section 303.O.3 (Page 303-16) only for specific items described:

- A. Removal of wall and column forms shall not be started any sooner than 24 hours of accumulated time with the ambient air temperature above 50 degrees F after completion of the wall or column pour, respectively.
- B. Wall and column forms may be removed as soon as the concrete has developed sufficient strength to prevent sagging, excess deflection, misalignment, spalling, cracking, breaking of edges and surfaces and any other damage to the concrete and the compressive strength of the concrete has reach a minimum of 50% of the required 28-day compressive strength confirmed by concrete cylinder tests. If the Contractor decides to remove forms prior to 14 days, at the Contractor's own expense, additional concrete cylinder shall be molded and cured as specified here-in to verify that the 50% strength requirement above has been achieved, prior to removing the forms.
- C. Removal of roof forms will be permitted only when the concrete has attained the compressive strength equal to the required 28-day compressive strength specified in these Special Provisions or shown on the Drawings, but no earlier than 14 days regardless of the concrete compressive strength. Add following items to the end of Section 303.03.O.3, "Form Removal":
- D. Contractor shall remove all wood splinters on concrete surfaces after stripping of wood forms.

### 3.6 CONVEYING, PLACING, AND HANDLING:

Add the items below the end of Section 303.03.P, "Conveying, Placing and Handling":

- A. Concrete in columns, having no horizontal reinforcement crossing into the region bounded by the vertical reinforcement, may be deposited from the top of the column form, at Contractor's option such that no separation of the coarse aggregate from the mortar takes place. All concrete shall be vibrated as required herein. The final quality of the poured concrete column shall be the responsibility of the Contractor. If the quality of the column is found to be unacceptable the Engineer, at the Contractor's expense, may require the complete removal of the column and may require that an alternate placement method be used.

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- B. Each layer of concrete in walls and columns shall be vibrated thoroughly before the next layer may be placed thereon. Vibrators shall be taken through the top layer down through the full layer thickness below to ensure proper integration of the concrete and to avoid the development of cold joints and honeycomb between the layers. In other words, each layer of concrete shall be vibrated at least twice.
- C. Horizontal waterstops in floor and roof decks, if shown on the Drawings, shall be lifted up, then the concrete shall be placed under the waterstop, the waterstop shall then be laid down on that concrete, additional concrete shall be placed on top of that waterstop to the approximate finish level of the concrete, where upon the concrete shall be thoroughly vibrated in one continuous motion from one end of the waterstop to the other end without skipping any areas. Visual observation shall be performed by the Contractor to certify that voids under waterstops have been eliminated.
- D. Cold joints between bulkheads in floor, roof slabs and in wall footings shall be avoided at all costs. Joints shall be continuously covered with new concrete, and shall be thoroughly integrated through vibration, even if it means that horizontal passes of only 6 inches in width be made until additional concrete and equipment becomes available to permit wider passes in concrete placement.
- E. Protect concrete placed immediately before rain to prevent rainwater from coming in contact with it. Keep sufficient protective covering on hand at all times for this purpose.
- F. Pumping Concrete
  - 1. Slab screeds and bulkheads shall be set to specified alignment and elevations permitting a maximum tolerance of 1/4 inch plus or minus.
  - 2. Before pumping is started, prime the delivery pipe or hose by pumping mortar through the line using 5 gallons of mortar for each 50 feet of delivery pipe. Do not deposit mortar in the forms.

### 3.7 SURFACE FINISHES

Add the following items to the end of Section 303.03.S, "Surface Finishes":

- A. Form Tie Holes Patching: The surface form tie holes in the wall surfaces shall be roughened or abrasion blasted and cleaned, the tie holes shall then be coated with a water insensitive epoxy or an acceptable bonding agent and properly filled by damp-packing with a mortar of drypack consistency. The mortar shall have a mix of one part of cement to one-part sand ratio. The amount of added water to the cement-sand mix shall be such that the mortar can be driven into the voids and will compact properly. The outside tie holes shall not be drypacked any sooner than 7 days after the inside holes have been drypacked.

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#### B. Reservoir Concrete Finishes Schedule

1. Reservoir floor: Wood-float surface conforming to specified slope.
2. Top of Wood-float surface conforming to specified slope.
3. Reservoir wall, columns and outside edge of roof slab and wall footing: See WSS Section 303.06.C.6.
4. Reservoir roof slab: The top surface shall receive a steel trowel finish which is subsequently swept with a steel or hard-bristled broom to leave a fine uniformly scratched concrete surface.

#### C. Wood-Float Finish

1. This finish requires an integral finish by wood-float after screeding, to compact the surface evenly.
2. Any excess surface water shall be removed before floating and no mortar shall be used for leveling.

#### D. Steel Trowel Finish

1. This shall be an integral finish obtained by trowelling with a steel trowel after the surface has been floated and allowed to stand until all water-sheen has disappeared.
2. Finish shall be an integral finish obtained by trowelling with a steel trowel after the surface has been floated and allowed to stand until all water-sheen has disappeared.
3. Cement, or mixture of cement and sand, shall not be spread on surfaces to absorb excess water or to stiffen the concrete.
4. Trowelling shall produce a dense, smooth, impervious surface free from defects and blemishes.

### 3.8 CURING COMPOUND

- A. Curing compound shall only be allowed for non-reservoir concrete with the approval of the Department of Land and Natural Resources. Curing compound shall conform to ASTM C309. Application shall be as per manufacturer's printed instructions.

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### 3.9 PROTECTING AND CURING

Replace Section 303.03.R “Protecting and Curing” with the following:

- A. All fresh concrete shall be adequately protected from injurious action by the sun, heavy rains and mechanical injury and shall not be allowed to dry out from the time it is placed until the expiration of the minimum curing period specified here.
- B. For the reservoir, all horizontal, screeded and floated surfaces, exposed to drying winds and sunlight, shall be sprayed with a curing compound at an application specified by the manufacturer. After the surface is dry to the touch, a curing blanket consisting of at least 10 oz. burlap and 4 mil thick white opaque polyethylene in conformance with ASTM C-171, shall be carefully taped and sealed over the concrete surface and kept on such surface for as long as possible, but for at least 10 days, to minimize the loss of moisture trapped between the polyethylene and the concrete. The polyethylene covering will not be required for new wall construction.
- C. As an alternative to the two-step process described above a wet curing method as described in WSS Section 303.03.R can be used for at least 10 days.
- D. For the reservoir walls, all formed concrete surfaces shall be sprayed with a concrete curing compound immediately after the forms are removed at a coverage rate specified by the manufacturer. This requirement will be waived if the forms are left in place for at least 7 days.
- E. Prior to placing the reservoir in service or the surface is coated, the surfaces coated with curing compound shall be pressure blasted with water or abrasive to completely remove the compound.
- F. For concrete curing for structures other than reservoir concrete, in addition to the curing methods listed, the Contractor may use a curing compound that complies with ASTM C-309 and is compatible with any paints or toppings to be applied. Wax-based curing compounds will not be permitted.
- G. The Engineer reserves the right to reject concrete that was not provided with the specified curing.
- H. Delete the second sentence from the first paragraph in Section 303.12.A “Protection of Reservoir - General”.

### 3.10 CONCRETE REPAIR

- A. Defective surfaces, such as honeycomb, shall be cut out entirely until homogeneous concrete is met, even if it means going through the entire wall, floor or roof slab.
- B. Such areas shall be coated with a two-component, 100% solids, moisture-tolerant, NSF 61 conforming, high-modulus structural epoxy paste bonding material, such as

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Sikadur 31, Hi-Mod Gel by Sika, which shall be applied in accordance with the manufacturer's instructions, before damp-packing the area with a mix consisting of one part of Portland cement and two parts of sand and fine gravel, epoxy and sand mix, or any combination of materials and mixes as the situation dictates in the opinion of the Engineer.

- C. The water content of the repair mortar material shall be such that a ball of the mix may be squeezed in the hand without bringing free water to the surface.
- D. Repair mortar material shall be tamped into place and finished to match adjacent concrete surfaces.
- E. If a patch is required to the applied in multiple lifts, an approved epoxy bonding agent shall be applied between lifts.
- F. Surfaces which have been damp-packed shall be kept continuously damp to cure for a period of not less than seven days after completing the damp-pack operation, by the curing procedure described below.
- G. Neither Embeco, calcium chloride or fast-setting cements/additives shall be used for filling honeycomb areas, nor shall they be mixed with damp-pack material. Contractor shall provide certification that any material placed on or in the concrete wall shall be free of chlorides and other materials corrosive to reinforcing steel.

### 3.11 EPOXY ADHESIVE INJECTION OF CONCRETE CRACKS

- A. Repair Criteria: All cracks with a width of 0.015 inches or larger shall be repairs using this procedure.
- B. Epoxy injection shall be performed by a manufacturer trained and certified applicator.
- C. Contractor's/Subcontractor's operator engaged in the epoxy injection process shall have satisfactory operator experience in the methods of restoring concrete structures utilizing the specific epoxy injection process indicated. Operator's experience shall include previous repairs of cracked or damaged concrete structures, the technical knowledge of correct material selection and use, and the operation, maintenance and troubleshooting of equipment.
- D. Epoxy Resin Adhesive for Injection: Epoxy adhesive shall be 100% solids, 2-part water insensitive, low-viscosity epoxy resin. Epoxy shall be suitable for repairing both dry and damp cracks. Epoxy shall develop a minimum tensile strength (ASTM D695) of 6,000 psi and a minimum compressive strength of 8,000 psi (both at 28 days). Products meeting these requirements include SELECT BOND GP-4440, as manufactured by SPC, Costa Mesa, CA; SIKADUR 35, HI-MOD LV as manufactured by Sika Corp., Lyndhurst, NJ or approved equal.

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E. The crack surface seal material shall have adequate strength to hold injection fittings firmly in place and to resist injection pressures adequately to prevent leakage during injection. The material shall be compatible and from the same manufacturer as the epoxy resin adhesive product.

F. Pressure Injection Equipment:

1. The equipment used to meter and mix the two injection adhesive components and inject the mixed adhesive into the crack shall be portable, positive-displacement type pumps with interlock to provide positive ratio control of exact proportions of the two components at the nozzle. The pumps shall be electric or air powered and shall provide in-line metering and mixing.
2. The injection equipment shall have automatic pressure control capable of discharging the mixed adhesive at any pre-set pressure up to 200 psi plus or minus 5 psi and shall be equipped with a manual pressure control override.
3. The injection equipment shall have the capability of maintaining the volume ratio for the injection adhesive prescribed by the manufacturer of the adhesive within a tolerance of plus or minus 5 percent by volume at any discharge pressure up to 200 psi.

G. Injection Equipment Pressure Test:

1. The mixing head of the injection equipment shall be connected and the equipment run until clear uniformly mixed material flows into the purge pail. The Operator shall engage the equipment shut-off nozzle valve and subsequently bump the on-off switch until the pressure reaches 200 psi. If pressure is maintained between 190-200 psi for one minute, check valves shall be considered to be functioning properly and the injection may proceed. If pressure drops below 190 psi, Contractor shall be required to have new seals installed on the check valves and the equipment shall be subsequently retested.
2. The pressure test shall be run for each injection unit at the beginning and after meal breaks of every shift that the unit is used.
3. The adequacy and accuracy of the equipment shall be solely the responsibility of the Contractor.

H. Mix Ratio Test:

1. The epoxy mixture ratio shall be monitored continuously while injecting by placing a strip of masking tape on the sides of the A & B reservoirs full height. After filling reservoirs, the A & B levels shall be marked and monitored while running injection machine into purge pail for a period of one minute. The difference in liquid height shall then be compared to verify the correct volume ration is being dispensed.

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2. If the dispensing ratio is incorrect, the equipment shall be adjusted and retested.
3. The ratio test shall be run for each injection unit at the beginning and after meal breaks of every shift that the unit is used.

I. Proof of Mix Ratio Test:

1. At all times during the course of the work the Contractor shall keep complete and accurate records available to the Engineer of the equipment pressure and mix ratio tests specified above.
2. In addition, the Engineer at any time without prior notification of the Contractor, may request the Contractor to conduct the tests specified above in the presence of the Engineer.

J. Injection Repair Preparation:

1. The substrate surface at the seal material application shall be clean, no dirt, dust, grease, oil, efflorescence or other foreign matter that may be detrimental to the integrity of the epoxy bond. Acids and corrosives shall not be permitted to be used.
2. Entry ports shall be placed along the crack spaced not more than the thickness of the concrete section to be repaired.
3. Surface seal material shall be applied to the face of the crack between the entry ports. For through cracks, surface seal shall be applied to both faces, where possible.
4. Surface seal material shall be allowed to cure to gain adequate strength before proceeding with pressure injection.

K. Epoxy Adhesive Injection:

1. Begin injection at lower entry port for vertical applications and at one end of the crack in horizontal applications, continuing until epoxy adhesive appears at the next entry port in line.
2. Epoxy injection shall progress along the crack to the next adjacent port where epoxy adhesive has appeared.
3. Epoxy adhesive injection shall be performed sequentially along the ports until cracks are completely filled.
4. If port-to-port travel of epoxy adhesive is not achieved, the work shall immediately be stopped and the Engineer notified.

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L. Finishing:

1. After cracks are completely filled, epoxy adhesive shall be cured to prevent any draining or runback of epoxy material from cracks.
2. Any surface seal material, injection ports and injection adhesive shall be removed from concrete surfaces.
3. The face of the crack shall be finished flush to the adjacent concrete surface showing no indentations or protrusions caused by the placement of entry ports.

PART 4 – PAYMENT

Payment will not be made directly but shall be included in the Lump Sum Bid of which it is a part. Such payment shall represent full compensation for furnishing all materials, labor, tools, equipment and incidentals required to complete the work.

END OF SECTION

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## SECTION 05500

### MISCELLANEOUS METALS FABRICATION

#### PART 1 – GENERAL

##### 1.1 GENERAL REQUIREMENTS

- A. Description. Furnish of all labor, materials, tools and equipment necessary for completing metal item fabrication and installation complete covered in this specification.
- B. This section includes the following:
  - 1. Stainless Steel Interior Ladder
  - 2. Exterior Galvanized Steel Ladder
  - 3. Pre-Fabricated Stainless-Steel Fall-Prevention System
  - 4. Galvanized Steel Railing
  - 5. Roof Access and Observation Hatches
  - 6. Overflow Pipe Supports

##### 1.2 SUBMITTALS

- A. Provide product data for the following:
  - 1. Pre-fabricated ladder stainless steel fall protection system
  - 2. Structural adhesive for post installed anchorage
  - 3. Galvanized Steel Railing
- B. Shop Drawings: Detail fabrication and erection of each metal fabrication member indicated. Include plans, elevations, sections, and details of metal fabrication members and their connections. Show anchorage and accessory items.
- C. Calculations: Provide aluminum rail system manufacturer's calculations demonstrating the system capacity meets OSHA loading requirements.
- D. Provide templates for anchors and bolts specified for installation to be coordinated with other work.
- E. Manufacturer's installation instructions and rough-in dimensions for manufactured items.

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- F. Welding Certificates: Copies of certificates for welding procedures and personnel.
- G. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

### 1.3 QUALITY ASSURANCE:

- A. Fabricator Qualifications: A firm experienced in producing metal fabrications similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units within the project schedule.
- B. Welding: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1, "Structural Welding Code--Steel."
  - 2. AWS D1.6, "Structural Welding Code—Stainless Steel."
  - 3. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

### 1.4 DELIVERY, STORAGE, AND HANDLING:

- A. Exercise proper care in handling of Work so as not to damage finished surfaces. Protect Work from damage after it is in place.
- B. Store materials under cover in a dry and clean location off the ground in manner that will not distort and bend assembly. Remove materials that are damaged or otherwise not suitable for installation from job site and replace with acceptable materials at no additional cost to the Department of Land and Natural Resources.

### 1.5 PROJECT CONDITIONS:

- A. Field Measurements: Where metal fabrications are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

### 1.6 COORDINATION:

- A. Coordinate installation of anchorages for metal fabrications, ladders and railing. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete. Deliver such items to Project site in time for installation.

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## 1.7 SCHEDULING:

- A. Schedule installation of ladders and railings for mounting to occur only to completed concrete construction with required curing time. Do not support temporarily by any means that does not satisfy structural performance requirements.
- B. Scheduling painting of existing elements to be painted prior to installation of new work that will conceal or make the surface inaccessible.
- C. If epoxy anchors are installed, Contractor shall arrange for special inspection for their installation. Deputy inspector's report shall be submitted to the Engineer.

## PART 2 – MATERIALS

### 2.1 MATERIALS

- A. Structural Steel Plate or Angle Shapes: ASTM A36, unless noted otherwise.
- B. Stainless Steel Bars and Shapes: ASTM A276, Type 316, unless noted otherwise.
- C. Stainless Steel Sheets, Strip, and Plates: ASTM A666, Type 316, unless noted otherwise.
- D. Stainless Steel Pipes: ASTM A312, Grade TP 316, unless noted otherwise.
- E. Stainless Steel threaded rod or headed bolts: ASTM F593 (AISI 316).
- F. Stainless Steel nuts shall be Type 316 conforming to ASTM F594 with Teflon-coated hex nuts, where indicated, with flat washers.
- G. Hot-dipped Galvanizing: Where galvanized steel rolled pressed and forged shapes, plates, bars, and strips are specified, the steel shall be galvanized in conformance with ASTM A123, unless noted otherwise. Galvanizing of steel hardware (bolts, nuts, etc.) shall be in conformance with ASTM A153, unless noted otherwise.
- H. Welding Rods and Filler Metal: Provide type and alloy of filler metal and electrodes as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items. Select according to AWS specifications for metal alloy welded.
- I. Non-shrink, Non-metallic Grout: Factory-packaged, non-staining, non-corrosive, non-gaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for exterior applications.
- J. Structural Adhesive Epoxy: Factory-packaged, two-component, non-shrink, low-odor, 100% solids epoxy-based adhesive for use as a structural adhesive with a

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current ICC Evaluation Services, ES Report for both cracked and un-cracked concrete, such as Simpson “SET-XP” or Hilti “HIT RE 500-SD” or approved equal.

K. Zinc-rich Cold Galvanizing Coating: Coating shall contain a minimum of 92% zinc by weight after drying and designed for spot-priming damaged galvanized surfaces.

1. Products such as Galvax by Alvin Products, Everett, MA ([www.alvinproducts.com](http://www.alvinproducts.com)) or Z.R.C. by ZRC Worldwide, Marshfield, MA ([www.zrcworldwide.com](http://www.zrcworldwide.com)) meet the above requirements or approved equal

L. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers, or cold-applied asphalt emulsion complying with ASTM D 1187.

## 2.2 STAINLESS STEEL INTERIOR LADDER AND GALVANIZED STEEL EXTERIOR LADDER:

- A. Fabricate ladder for location shown, with dimensions, spacing, details, and anchorages as indicated and in accordance with WWS Section 303.22.G.
- B. Siderails: Continuous stainless-steel pipe section, size and spaced as indicated on Drawings.
- C. Bar Rungs: 3/4-inch minimum diameter solid steel bars, spaced 12 inches on center. Provide non-slip surfaces on top of each rung by coating with abrasive material bonded to rung by a proprietary process designed for use in potable water or the surface can be knurled to provide a slip-resistant textured surface.
- D. Fit rungs in centerline of side rail pipes; insert rung 1 inch minimum into pipe section; fillet weld circumference of rung.
- E. Support ladder at top and bottom as detailed on Drawings.
- F. Measure existing conditions to provide connection plates and ladder of proper length and orientation to properly fit. Verify fit-up before installing epoxy anchors.
- G. After ladder position is plumb and straight, the drilled and epoxy anchors shall be installed to anchor the ladder as shown in the Drawings.
- H. Form and cast concrete ladder base pad onto roughened surface coated with concrete bonding agent after the ladder has been secured to the roof slab.
- I. Concrete base pad to properly cure before utilizing the ladder.

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### 2.3 FASTENERS:

- A. General: Provide Type 316 stainless-steel fasteners or as specified on construction documents.
- B. Bolts and Nuts: Type 316 stainless steel hexagon-head bolts, ASTM F597 with Teflon-coated hex nuts, ASTM F 597, where indicated, flat washers.
- C. Lock Washers: Helical, spring type, stainless steel.
- D. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

### 2.4 RESERVOIR ROOF ACCESS HATCH:

- A. The roof hatches shall be "Hawaii" Style Light Duty Aluminum Hatch by SYRACUSE CASTINGS SALES CORP., as distributed by B.K., Inc, Hilo, Hawaii Phone: 808-961-2125.
- B. Top Mount – Single or double leaf hatch, see Drawings. Frame opening width and opening length as indicated on the Drawings.
- C. Material shall be 6061-T6 aluminum for bars, angles and extrusions, 1/4" diamond plate shall be 5086 aluminums.
- D. Unit to be constructed per AWWA Standard for tank openings stating, "Hatches should be constructed as to prevent leakage into the tank and locked to resist unauthorized entry and vandalism." Shall be constructed to eliminate infiltration of pests into water storage tanks.
- E. Covers shall be turn down 2" over curb (4" tall angle frame). Angle Frame shall be of extruded aluminum with an integral seat. Angle frame shall be a minimum 4" tall and 1/4" thick. Unit designed for 625 lbs/sq. ft.
- F. Covers shall be equipped with a hold open arm. Door shall lock open in the 90-degree position. Each hold open arm shall be fastened to the frame with a 1/2" grade 316 stainless steel bolts.
- G. All hardware shall be stainless steel. Each hatch shall be supplied with an exposed padlock clip for owner's padlock.
- H. Unit supplied with "Rimseal" gasket on vertical leg of angle. "Rimseal" to be pressed tightly against cover by aluminum pressure locks (swing bolts).

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- I. Doors balanced to require less than 30 lbs opening force.
- J. Install graphite pad and silicone gasket between frame and concrete.

## PART 3 – EXECUTION

### 3.1 STEEL FABRICATION - GENERAL

- A. Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use only welded connections for steel member connections. Clearly mark units for reassembly and coordinated installation.
- B. Fabricate metal items to comply with indicated dimensions, member sizes and spacing, details, finish, and anchorage.
- C. Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work. Shear and punch metals cleanly and accurately. Remove burrs.
- D. Welded Connections: Fabricate railing by welding members. For all welded connections, cope components at perpendicular and skew connections to provide a close fit. Weld connections continuously to comply with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
  - 5. Fabricate joints in a watertight manner.
  - 6. Form work true to line and level with accurate angles and surfaces and straight sharp edges.
  - 7. Remove sharp or rough areas on exposed traffic surfaces. Close exposed ends of railing members with fitted and welded ends.
  - 8. Railing connections shall not require any field welding or rivets for assembly.

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### 3.2 GALVANIZING:

- A. Components specified as galvanized, shall be in accordance with ASTM A123 and all applicable documents listed herein.
- B. Where fabricated pieces are too large to be galvanized as a single unit, the fabricated piece may be broken down into smaller units to be welded or bolted together after galvanizing. The location of all added connections must be clearly identified as such on a shop drawing submitted to the Engineer for approval.
- C. Galvanizing shall be repaired at all locations of welding in accordance with methods A1 or A3 of ASTM A780.
- D. Repairs of other defects such as those caused by inadequate surface preparation, failure to remove weld slag, rough welding, poor galvanizing practice or defects due to any other causes shall only be accepted or approved by the Engineer after inspecting the item after delivered to the jobsite.

### 3.3 FALL-PREVENTION SYSTEM:

- A. The fall prevention system to be mounted on ladders where specified on the Drawings, shall be a manufactured item. The manufacturer shall have a minimum of 10 years of experience manufacturing the product provided for this project. The system shall meet the requirements of OSHA requirements of Standards 29 CFR, Part 1910.27(d)(5) and 1926.1053.
- B. The fall prevention system shall be constructed from stainless steel, the same material as the ladder.
- C. The fall prevention system shall consist of a vertical 3/8-inch minimum diameter flexible cable with a shock-absorbing top bracket and tension indicating bottom bracket serving as the anchors for the steel cable which runs the full length of the ladder. The top bracket shall be designed to telescope upward from a position close to the top rung of the ladder to a height three feet above the top rung when the hatch cover is open.
- D. A swiveling cable sleeve shall be designed to prevent falls by locking onto the cable. It shall be designed to be attached or removed from the cable anywhere along the cable and automatically follow as one climbs or descends.
- E. Three woven nylon safety harnesses with an integrated belt design to attach to the cable sleeve shall be provided as part of this contract. The harnesses shall be adjustable and include front and back "D" rings and padded straps and three cable sleeves.
- F. The system shall be designed to be installed to a metal ladder with standard wrenches, with cable guides designed to allow a person to ascend or descend unhindered and

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shall be equipment with a built-in cable tensioner to indicate when the system is at the proper cable tension.

- G. The fall protection system shall be installed and inspected in accordance with the manufacturer's installation manual.
- H. Product information describing the components and features of the proposed system shall be provided to the Engineer for review.
- I. Product and Manufacture:
  - 1. 'Lad-Saf' ladder safety system by DBI/SALA, Red Wing, MN (800) 328-6146, [www.salagroup.com](http://www.salagroup.com)
  - 2. 'Miller Transcendor Cable Climbing System' by Honeywell Miller, Franklin, PA (800) 873-5242
  - 3. Approved equal

### 3.4 RAILING INSTALLATION

- A. Provide railing in a timely manner, not to delay progress of construction.
- B. Perform cutting, drilling, and fitting required for installing railing as shown on Contract Drawings. Install members accurately in location, alignment, and elevation; with posts, rails level, plumb, true, and free of rack; and measured from established lines and levels.
- C. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
- D. Railing post bases to be installed on leveling grout (if required), after railing is properly located for installation, bases shall be secured as detailing in Project Drawings.
- E. Railing to be bolted into place with drilled and epoxy anchors shall be plumbed and leveled and secured in place prior to installation of anchors. Anchors shall be installed per installation requirements of product's ICC Research Report. All epoxy anchors require special inspection by deputy inspector during installation.

### 3.5 ROOF ACCESS HATCH AND FRAME INSTALLATION:

- A. Install miscellaneous specialties as indicated on the drawings. The cover frame shall be installed flush with the concrete surface.

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### 3.6 DISSIMILAR METAL SEPARATION:

- A. For member-to-member contact, provide two layers of separation tape between dissimilar metals.
- B. For fasteners of dissimilar metal relative to the base material, provide insulating washers under nuts and bolt or screw heads designed to separate dissimilar metals.

### PART 4 – PAYMENT

Payment will not be made directly but shall be included in the Lump Sum Bid of which it is a part. Such payment shall represent full compensation for furnishing all materials, labor, tools, equipment and incidentals required to complete the work.

END OF SECTION

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## SECTION 06600

### FIBERGLASS REINFORCED POLYMER (FRP) PRODUCTS AND FABRICATION

#### PART 1 – GENERAL

##### 1.1 GENERAL DESCRIPTION

- A. Description. This item of work shall include the furnishing of all labor, materials, tools and equipment necessary for the fabrication and installation work of Fiberglass Reinforced Polymer (FRP) products, in place complete, as specified hereafter and in accordance with the project drawings.

##### 1.2 SUBMITTALS

- A. Shop drawings of all fabricated pultruded or molded gratings and appurtenances shall be submitted to the Engineer for approval. Show anchorage and accessory items.
- B. Product data, dimensions and spacing of elements and installation directions for manufactured items.
- C. Performance Data, span and load tables for the proposed grating product indicating the calculated live load deflection based on span and 100 psf live load.
- D. Qualification Data: The material covered by these specifications shall be furnished by an ISO-9001:2000 certified manufacturer of proven ability who has regularly engaged in the manufacture and installation of FRP systems.

##### 1.3 QUALITY ASSURANCE

- A. Fabricator Qualifications: Firm experienced in successfully producing FRP fabrications similar to that indicated for this project, with sufficient production capacity to produce required units without causing delay in the work.

##### 1.4 DESIGN CRITERIA

- A. The design of FRP products including connections shall be in accordance with governing building codes and standards and OSHA regulations as applicable.
- B. Design live loads of FRP gratings shall not be less than 100 psf uniformly distributed unless specifically stated otherwise in drawings and/or supplementary conditions. Grating deflection at the center of a simple span is not to exceed 0.25”.

##### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Exercise proper care in handling of Work so as not to damage finished surfaces. Protect Work from damage after it is in place. Store materials off the ground and in a

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manner that does not deform Work under its own weight. Remove materials that are damaged or otherwise not suitable for installation from job site and replace with acceptable materials at no additional cost to the Department of Land and Natural Resources.

- B. Grating shall be shipped from the manufacturer, palletized and banded with exposed edges protected to prevent damage in shipment.
- C. All FRP shall be stored before, during, and after shipment in a manner to prevent cracking, twisting, bending, breaking, chipping or damage of any kind to the materials or equipment, including damage due to over exposure to the sun. Any material which, in the opinion of the owner, has become damaged as to be unfit for use, shall be promptly removed from the site of work, and the Contractor shall receive no compensation for the damaged material or its removal.
- D. Where FRP fabrications are indicated to fit other construction, verify dimensions by field measurements before fabrication and indicate these measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

## PART 2 – MATERIALS

### 2.1 GENERAL

- A. Materials used in the manufacture of the FRP products shall be raw materials in conformance with the specification.
- B. All FRP products noted herein shall be manufactured using a pultruded process utilizing polyester ester resin with flame retardant and ultraviolet (UV) inhibitor additives. A synthetic surface veil shall be the outermost layer covering the exterior surface. The flame retardant FRP shapes shall achieve a flame spread rating of 25 or less in accordance with ASTM test method E-84.
- C. If required, after fabrication, all cut ends, holes and abrasions of FRP shapes shall be sealed with a compatible resin coating.
- D. All exposed surfaces shall be smooth and true to form.

### 2.2 PULTRUDED GRATING

- A. The bearing bars shall be joined into panels by passing continuous length fiberglass pultruded cross-rods through the web of each bearing bar. A continuous fiberglass pultruded bar shaped section shall be wedged between the two cross rod spacers mechanically locking the notches in the cross-rod spacers to the web of the bearing bars. Continuous chemical bonding shall be achieved between the cross-rod spacers and the bearing web and between the bar shaped wedge and the two cross rod spacers

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- locking the entire panel together to give a panel that resists twist and prevents internal movement of the bearing bars.
- B. The top surface of all grating and treads shall have a non-skid grit affixed to the surface by an epoxy resin followed by a top coat of epoxy resin. Color shall be high visibility yellow.
  - C. Grating shall be fabricated to the sizes shown on the drawings.
  - D. Hold down clamps shall be type 316L stainless steel insert hold downs as provided by manufacturer. Use 2 at each support with a minimum of 4 per grating panel.
  - E. All bearing bars that are to be exposed to UV shall be coated with polyurethane coating of a minimum thickness of 1 mil.

### PART 3 – EXECUTION

#### 3.1 INSTALLATION

- A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions and directions for installation of anchorages. Coordinate delivery of such items to project site.
- B. Fastening to in-place construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous FRP fabrications to in-place construction; all fasteners shall be type 316 stainless steel, unless noted otherwise.
- C. Cutting, fitting and placement: Perform cutting, drilling and fitting required for installation of miscellaneous FRP fabrications. Set FRP fabrication accurately in location, alignment and elevation; with edges and surfaces level, plumb, true and free of rack; measured from established lines and levels.
- D. All field cut and drilled edges, holes and abrasions shall be sealed with a catalyzed resin compatible with the original resin as recommended by the manufacturer.
- E. Grating shall be installed to bear evenly on supports and shall not rock after anchored to supports. Follow manufacturer's recommendations for installation and joint gap tolerance of grating panels.

### PART 4 – PAYMENT

No separate payment for will be made; compensation for such work shall be deemed to be included in the Lump Sum Bid for the item of which it is a part.

END OF SECTION

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## SECTION 07500

### FLUID-APPLIED ROOFING SYSTEM

#### PART 1 – GENERAL

##### 1.1 GENERAL REQUIREMENTS

- A. Description. Furnish of all labor, materials, tools and equipment necessary for the complete installation of fully reinforced cold fluid-applied polymethyl methacrylate (PMMA) liquid resin roofing membrane and membrane flashing system where indicated on the drawings.
- B. This section includes the following:
  - 1. Adhered cold liquid-applied reinforced waterproofing system including, membrane, penetration flashings, base flashings, expansion joints, and non-skid finish.
  - 2. Substrate preparation, cleaning, after leveling and patching.
  - 3. Waterproofing membrane installation.
  - 4. Flashing installation and expansion joint installation.

##### 1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM) ASTM C 836 Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane
- B. National Roofing Contractors Association (NRCA) Roofing and Waterproofing Manual
- C. American Concrete Institute (ACI) ACI-308 - Recommended Practice for Curing Concrete
- D. ASTM - D638 - Test Methods for Tensile Properties of Plastics
- E. ASTM - D4258 - Standard Practice for Surface Cleaning Concrete for Coatings
- F. ASTM - D4259 - Standard Practice for Abrading Concrete
- G. ASTM - D4541 - Method for Pull-Off Strength of Coatings using Portable Adhesion Tester
- H. ASTM - E96(A) - Test Methods of Moisture Transmission of Material

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- I. ASTM E-108, ANSI/UL 790 for fire resistance
- J. Steel Structures Painting Council (SSPC)

### 1.3 SUBMITTALS

- A. Roofing System Product Data: Provide current standard printed product literature indicating characteristics of membrane materials, flashing materials, components, and accessories, product specification, and installation.
- B. Product Samples: Submit product samples of membrane and flashing materials showing color, texture, thickness and surfacing representative of the proposed system for review and approval by Engineer.
- C. Submit sample copies of both the Manufacturer and Applicator warranties for the periods stipulated. Each specimen must be a preprinted representative sample of the issuing company's standard warranty for the system specified.
- D. Submit copies of current Material Safety Data Sheets (MSDS) for all components of the work.
- E. Submit documentation from the roofing system manufacturer to verify contractor's status as an approved applicator for warranted installations.
- F. Roofing System Shop Drawings: Submit shop drawings of cold liquid-applied reinforced unsaturated polyester showing a project plan, size, flashing details, and attachment for review and approval by the Engineer and roofing system manufacturer.
- G. Provide certificates for the following;
  - 1. Roofing System Manufacture: Manufacture has been manufacturing product specified for the past 10-Years.
  - 2. Roofing Contractor: Provide list of projects, including address, contact information, type of products installed and square footage.
- H. Contractors performing repair work on the reservoir must take every precaution necessary to preserve the water quality of the reservoir. Contractor shall submit a plan of work procedures that will prevent debris, dust, and other airborne particles from entering the reservoir for the approval by the Engineer.

### 1.4 QUALITY ASSURANCE

- A. Roofing System Manufacturer: Company specializing in manufacturing the products specified in this section with ten (10) years documented experience.

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1. Submit the following certificate when making substitution request.
  - a. Roofing System Manufacture: Manufacturer has been manufacturing proposed product for the past 10-Years.
- B. Applicator: Company specifically trained in performing the work of this section with (3) years documented experience and approved by system manufacturer for warranted membrane installation. Applicator shall submit the following certification for review:
  1. Applicator shall submit documentation from the roofing system manufacturer to verify contractor's status as an approved applicator for warranted installations.
- C. Calculate moisture content of substrate materials. Contractor shall determine substrate moisture content through-out the work and record with Daily Inspection Reports or other form of reporting acceptable to the Engineer or designated representative, and roofing system manufacturer representative.
- D. Random tests to determine tensile bond strength of membrane to substrate shall be conducted by the Contractor at the job site using an Elcometer Adhesion Tester Model 106 or similar device, or by the performance of a manual pull test. Contractor shall perform tests at the beginning of the Work, and at intervals as required to assure specified adhesion with a minimum of three (3) tests per 5000 square feet. Smaller areas shall receive a minimum of three (3) tests. Test results shall be submitted to the Engineer and the roofing system manufacturer representative. Contractor shall immediately notify the Engineer and roofing system manufacturer in the event tensile bond test results are below specified values.
  1. Adequate surface preparation will be indicated by tensile bond strength of membrane to substrate greater than or equal to 116 psi.
  2. Adequate surface preparation will be indicated by 135□ peel bond strength of membrane to substrate such that cohesive failure of substrate or membrane occurs before adhesive failure of membrane / substrate interface.
  3. In the event the tensile bond strengths are lower than the minimum specified, additional substrate preparation is required. Repeat testing to verify suitability of substrate preparation.
- E. Contractor to monitor quantities of installed materials such as application of resin mixture, reinforcing fleece and flashing. Perform Work in accordance with manufacturer's instructions.
- F. Mock-up areas shall be used to determine required methods and tools to obtain degree of substrate preparation required by the roofing system manufacturer. Conduct tests as required above to verify that substrate preparation meets specified requirements. Tests shall include, but are not limited to, tensile bond strength and moisture content of substrate.

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1. Prepare and clean a three (3) foot by three (3) foot area of each substrate material type.
2. Submit findings in writing to Engineer and roofing system manufacturer.
3. Mock-up areas shall be maintained for quality control for the entire project.

#### 1.5 REGULATORY REQUIREMENTS

- A. Conform to applicable building and jurisdictional codes for roofing/waterproofing assembly and fire resistance requirements.
- B. Comply with requirements of OSHA, NIOSH or local governing authority for workplace safety.

#### 1.6 PRE-INSTALLATION MEETING

- A. Convene a pre-installation meeting at the job site one (1) week before starting work of this section. Require attendance of parties directly affecting work of this section, including but not limited to, Engineer, Roofing Contractor, and Roofing system Manufacturer's Representative. Review roofing/waterproofing preparation and installation procedures, mock-up installation location, coordination and scheduling required with related work, and condition and structural loading limitations of deck/substrate.

#### 1.7 DELIVERY, STORAGE, AND PROTECTION

- A. The Contractor, together with the Engineer, shall define a storage area for all components. The area shall be cool, dry, out of direct sunlight, and in accordance with manufacturer's recommendations and relevant regulatory agencies. Materials shall not be stored in quantities that will exceed design loads, damage substrate materials, or hinder installation or drainage.
- B. Store solvent-bearing solutions, resins, additives, inhibitors or adhesives in accordance with the MSDS and/or local fire authority. After partial use of materials replace lids promptly and tightly to prevent contamination.
- C. Roll goods shall be stored horizontally on platforms sufficiently elevated to prevent contact with water and other contaminants. DO NOT use rolls which are wet, dirty or have damaged ends.
- D. Roofing materials must be kept dry at all times. If stored outside, raise materials above ground or roof level on pallets and cover with a tarpaulin or other waterproof material. Plastic wrapping installed at the factory should not be used as outside storage covers.

- E. Follow manufacturer's directions for protection of materials prior to and during installation. Do not use materials which have been damaged to the point that they will not perform as specified. Fleece reinforcing materials must be clean, dry and free of all contaminants.
- F. Copies of all current MSDS for all components shall be kept on site. Provide any and all crew members with appropriate safety data information and training as it relates to the specific chemical compound he or she may be expected to deal with. Each crew member shall be fully aware of first-aid measures to be undertaken in case of incidents. Comply with requirements of OSHA, NIOSH or local governing authority for workplace safety.

#### 1.8 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply roofing membrane during or with the threat of inclement weather.
- B. Application of cold liquid-applied reinforced unsaturated polyester roofing membrane may proceed while air temperature is lower than 95°F providing the substrate is a minimum of 5°F above the dew point.
- C. Ensure that substrate materials are dry and free of contaminants. DO NOT commence with the application unless substrate conditions are suitable. Contractor shall demonstrate that substrate conditions are suitable for the application of the materials, including the vapor drive pressure at the time of installation.

#### 1.9 COORDINATION AND PROTECTION

- A. Coordinate the work with the installation of associated metal flashings, accessories, appurtenances, etc. as the work of this section proceeds.
  - 1. Building components shall be protected adequately (with tarp or other suitable material) from soil, stains, or spills at all hoisting points and areas of application. Contractor shall be responsible for preventing damage from any operation under its Contract. Any such damage shall be repaired at Contractor's expense to the owner's satisfaction or be restored to original condition.
  - 2. Provide barricades, retaining ropes, safety elements (active/passive) and any appropriate signage required by OSHA, NIOSH, and NSC and/or the Engineer.
  - 3. Protect finished roofing membrane from damage by other trades. Do not allow waste products containing petroleum, grease, acid, solvents, vegetable or mineral oil, animal oil, animal fat, etc. or come into direct contact with the membrane.

#### 1.10 WARRANTY

- A. Manufacturer's Premier Warranty: Provide (20) year manufacturer's premier warranty under provisions of this section. This warranty provides for cost of labor

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and materials for loss of water tightness, limited to amounts necessary to effect repairs necessitated by either defective material or defects in related installation workmanship, with no dollar limitation ("NDL").

- B. Waterproofing Contractor's Warranty: Provide 2 year "Applicator Maintenance Warranty" covering workmanship for all work of this section including installation of membrane, flashings, metal work, and waterproofing accessories.
- C. Submit (2) executed copies of both the manufacturer and applicator warranties for the periods stipulated, starting from the date of substantial completion. Each warranty must be signed by an authorized representative of the issuing company.

## PART 2 – MATERIALS

### 2.1 MATERIALS

- A. General: The products herein specified are totally pre-engineered products of the listed manufacturer and establish criteria for the approval of substitutions. Products must be part of a pre-engineered, reinforced liquid-applied roofing system, equivalent in function, quality, composition and method of application to be considered for approval as an "Approved Substitute".
- B. Roofing System: Cold fluid-applied reinforced polymethyl methacrylate waterproofing membrane. Provide products manufactured and supplied by the following:
  - 1. Kemper System's "Kemperol AC" is a two-component, rapid curing PMMA-based waterproofing system.
  - 2. Soprema "Alsan RS" PMMA Liquid Applied Solutions, 310 Quadral Drive, Wadsworth, OH 44281; Tel: 800-356-3521; Tel: 330-334-0066; Website: [www.soprema.us](http://www.soprema.us).
  - 3. Approved equal
- C. Membrane Flashings: A composite of the same resin material as field membrane with fleece reinforcement; colored aggregate topcoat surfacing or aliphatic polyester polyurethane coating to match field membrane.
- D. Accessories:
  - 1. PMMA Primer: Polymehtyl methacrylate resin for use in improving adhesion of membrane to wood, metal, and cementitious/masonry substrate surfaces, as provided by the following manufacturer:
    - a. Kemper System's Kempertec AC primer.

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- b. Soprema Alsan RS 276 Primer
  - c. Approved equal
- 2. PMMA Field Membrane: High performance, rapid-setting polymethyl methacrylate liquid resin, as provided by the following manufacturers:
  - a. Kemper System's Kemperol Membrane.
  - b. Soprema Alsan RS 230 Field
  - c. Approved equal
- 3. PMMA Reinforcing Fabric: Non-woven polyester reinforcement, 30 mil thickness.
  - a. Kemper System's Kemperol Fleece.
  - b. Soprema Alsan RS Fleece
  - c. Approved equal
- 4. Anti-Skid Aggregate Surfacing Finish Coating Resin: Two-component polymethyl methacrylate-based coating suitable for use to both bond and seal aggregate, as provided by the following Manufacturer:
  - a. Kemper System, Inc.'s Kemperdur AC Finish.
  - b. Soprema Alsan RS 289 Textured Base and Alsan RS Color Additive
  - c. Approved equal
- 5. Tools, Accessories, and Cleaners: Supplied and/or approved by roofing system manufacturer for product installation.
- 6. Topcoat Surfacing Aggregate: Kiln-dried Surfacing Silica Sand shall be washed, kiln-dried, and dust-free with a size specification of 16 Grit for the entire surface.
- 7. Leveling and Patching Aggregate: Silica sand shall be washed, kiln-dried, and dust-free, suitable for troweling or pourable self-leveling, round grain or angular with the following size specification:
  - a. For voids less than ¼" in depth: 20 Grit
  - b. For voids ¼" to 2" in depth: 20 Grit

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- c. Mixing Proportions shall be a ratio of resin to sand at 1:2 by volume for leveling, 1:4 by volume for patching, volume or as approved by roofing system manufacturer.
- 8. Backer Rod: Expanded, closed-cell polyethylene foam designed for use with cold-applied joint sealant.
- 9. Miscellaneous Fasteners: Appropriate for purpose intended and approved by roofing system manufacturer; length required for thickness of material; as supplied by roofing system manufacturer.
- 10. Caulking: Single component, non-sag elastomeric polyurethane sealant, as recommended or supplied by roofing system manufacturer for use in making airtight and watertight seals where required.
- 11. Temporary and Night Sealant: As recommended or required by roofing system manufacturer.

## PART 3 – EXECUTION

### 3.1 ROOFING SYSTEM INSTALLATION

#### A. Examination:

- 1. Verify that surfaces and site conditions are ready to receive work.
- 2. Verify deck/substrate openings, curbs, and protrusions through deck/substrate, and reglets are in place and solidly set.
- 3. Verify deck/substrate is structurally supported, secure and sound.

#### B. Preparation of Substrate:

- 1. General: Surfaces to be prepared as a substrate for the new waterproofing system as follows:
  - a. The contractor shall determine the condition of the existing structural deck/substrate. All defects in the deck or substrate shall be corrected before new waterproofing work commences. Areas of deteriorated deck/substrate, porous or other affected materials must be removed and replaced with new to match existing.
  - b. Existing slab joints shall be prepared and covered as recommended by manufacturer prior to installation of roofing system.
  - c. Prepare flashing substrates as required for application of roofing system flashings.

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- d. Inspect substrates, and correct defects before application of roofing system. Fill all surface voids greater than 1/8 inch wide with an acceptable fill material.
- e. Remove all ponded water, from the work substrate prior to installing roofing system materials.
- f. The final substrate for roofing system shall be clean, dry, free of loose, spalled or weak material including coatings, mineral aggregate, and flood coat/gravel surfacing, oil, grease, contaminants, abrupt changes in level, waterproofing agents, curing compounds, and free of projections which could damage membrane materials.

2. Concrete:

- a. Concrete shall be free of oil, grease, curing compounds, loose particles, moss, algae growth, laitance, friable matter, dirt, bituminous products and previous waterproofing materials.
- b. Concrete shall be dry with a maximum moisture content of five (5) percent. Determinations of moisture content shall be performed by the Contractor. Contractor shall be responsible to perform periodic evaluations of moisture content during the work. Moisture evaluation results shall be submitted in writing to the Engineer and the roofing system manufacturer representative.
- c. Where required, concrete shall be abrasively cleaned in accordance with ASTM D4259 to provide a sound substrate free from laitance with an open concrete surface. When using mechanical methods to remove existing waterproofing products or surface deterioration, the surface profile is not to exceed 1/8 inch (peak to valley).
- d. The substrate shall be sound and all spalls, voids and blow holes on vertical or horizontal surfaces must be repaired prior to placement of the primer coat. Spalls and other deterioration shall be repaired in accordance with the requirements of Section 31.1.O Concrete Repair of the Special Provisions.
- e. Areas of minor surface deterioration of 0.50-inch or greater in depth shall be repaired in accordance with the requirements of Section 31.1.O Concrete Repair to prevent possible ponding of the system, leading to excessive usage of primer and resin.
- f. Extent and location of thin surface patching shall require approval of the Engineer and roofing system manufacturer representative prior to the application of any system component.

3. Steel/Metal:

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- a. Clean and prepare metal surfaces to near white metal in accordance with SSPC - SP3 (power tool clean) or as required by roofing system manufacturer. Extend preparation a minimum of three (3) inches beyond the termination of the membrane flashing materials. Notch steel surfaces to provide a rust-stop.
  - b. Stainless steel (series 400, 300) shall be abraded to provide a rough open surface.
4. Other Surfaces: Remove all contaminants as required by roofing system manufacturer. Surface preparation shall be performed by means approved by Engineer.
5. Finish Leveling, Patching and Crack Preparation:
- a. General: polymethyl methacrylate primer/sand mix is the preferred material for all substrate finish leveling, crack and wall/deck preparation and patching. Resin/sand patching mix provides a fast-set time of approximately 12 hours and does not require surface grinding.
  - b. Substrate Leveling & Patching: Substrate conditions are to be evaluated by the Contractor, Engineer, and roofing system manufacturer. Perform leveling and patching operations as follows:
    - 1) Level uneven surfaces with a leveling mixture of unsaturated polyester resin/primer and approved kiln-dried silica sand in a 1:2 primer to sand ratio by volume. Spread and plane this compound with a squeegee and trowel to achieve a flat surface.
    - 2) Fill cavities with a patching mixture of primer and approved kiln-dried sand in a 1:4 primer to sand ratio by volume.
    - 3) Silica sand must be kept absolutely dry during storage and handling.
    - 4) Any surface to be leveled or filled must first be primed with an appropriate primer.
  - c. Joint and Crack Preparation: Joints, cracks and fractures in the structural deck/substrate shall be prepared as defined below prior to installation of the Roofing system.
    - 1) Non-Moving Cracks: Determine that crack is non-moving. Clean out crack by brushing and oil-free compressed air. Fill crack with polyurethane sealant. Allow for a minimum of twelve (12) hours cure or as required by sealant Manufacturer.
    - 2) Moving Cracks: Determine that crack is moving. Clean out crack by brushing and oil-free compressed air. Fill crack with polyurethane

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sealant. Allow for a minimum of twelve (12) hours cure or as required by sealant Manufacturer. Following full cure of primer, apply resin and 4-inch-wide strip of membrane (resin and fleece) in strict accordance with roofing system manufacturer's written instructions.

C. Primer Application:

1. General:

- a. Mix and apply two-component primer in strict accordance with written instructions of roofing system manufacturer. Use only proprietary materials, as supplied by the roofing system manufacturer.
- b. The substrate surface must be dry, with any remaining dust or loose particles removed using clean, dry, oil-free compressed air, industrial vacuum, cloth wipe or a combination of methods.
- c. Do not install primer on any substrate containing newly applied and/or active asphalt, coal-tar pitch, creosote or penta-based materials unless approved in writing by roofing system manufacturer. Some substrates may require additional preparation before applying primer.

D. Roofing System Application:

1. General:

- a. It is recommended to apply the waterproofing membrane immediately following full curing of the primer in order to obtain the best bond between primer and membrane.
- b. Mix and apply cold fluid-applied reinforced polymethyl methacrylate waterproofing membrane in strict accordance with written instructions of Membrane Manufacturer. Use only proprietary membrane resins and materials, as supplied by the membrane manufacturer.
- c. The primed substrate surface shall be dry, with any remaining dust or loose particles removed using clean, dry, oil-free compressed air, industrial vacuum, cloth-wipe or a combination.
- d. Protect all areas where membrane has been installed. Do not work off installed membrane during application of remaining work before twenty-four (24) hours of curing. Movement of materials and equipment across installed membrane is not acceptable. If movement is necessary, provide complete protection of affected areas.

- e. Closely follow the Membrane Manufacturer's recommendation for hot and cold weather application. Monitor surface and ambient temperatures, including the effects of wind chill.

E. Flashing Application:

1. General:

- a. Install flashing system in accordance with the requirements/recommendations of the roofing system manufacturer and as depicted on standard drawings and details. Provide system with base flashing, edge flashing, penetration flashing, counter flashing, and all other flashings required for a complete watertight system. Wherever possible, install the flashings before installing the field membrane to minimize foot traffic over newly installed field membrane.
- b. All membrane flashings shall be installed concurrently with the roofing system as the job progresses. Temporary flashings are not allowed without prior written approval from the roofing system manufacturer. Should any water penetrate the roofing system membrane because of incomplete flashings, the affected area shall be removed and replaced at the Contractor's expense.
- c. Provide a minimum vertical height of 8" for all flashing terminations, unless specifically detailed otherwise. Flashing height shall be at least as high as the potential water level that could be reached as a result of a deluging rain and/or poor slope. Do not flash over existing through-wall flashings or weep holes.
- d. All flashings shall be terminated as required by the roofing system manufacturer.

2. Membrane Flashing – General:

- a. Membrane flashings shall be fabricated with primer appropriate for the substrate surface, resin of the same base chemical type as the field membrane, and fleece of the same weight as the field membrane unless specified otherwise.
- b. Primer, resin, and fleece mixing and application methods as specified for field membranes are also suitable for membrane flashing.
- c. Fleece shall overlap 2 inches minimum for all joints. Fleece shall be cut neatly to fit all flashing conditions without a buildup of multiple fleece layers. Work wet membrane with a brush or roller to eliminate blisters, openings, or lifting at corners, junctions, and transitions.

3. Pipes, Conduits, and Unusually Shaped Penetrations:

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- a. Flash all penetrations using cold liquid-applied reinforced unsaturated polyester roof membrane with approved broadcast mineral aggregate surfacing or aliphatic polyester polyurethane coating. Flashing material shall be the same resin used in the field membrane with 165 fleece reinforcement.
  - b. Flashing is typically constructed as a two-part assembly consisting of a vertical wrap and a horizontal target patch. There must be a minimum of a two (2) inch overlap between vertical and horizontal flashing components.
4. Curb and Base Flashings:
- a. Wall, curb and base flashings shall be installed to solid substrate surfaces only. Adhering to gypsum-based panels, cementitious stucco, synthetic stucco, wood or metal siding, and other similar materials is not acceptable.
  - b. Reinforce all transition locations and other potential wear areas with a four (4) inch wide membrane strip evenly positioned over the transition prior to installing the exposed flashing layer.
  - c. Reinforce all inside and outside corners with a four (4) inch diameter conical piece of membrane prior to installing the exposed flashing layer.
  - d. All pins, dowels and other fixation elements shall be flashed separately with a vertical flashing component prior to installing the exposed flashing layer.
  - e. Extend flashing a minimum of four (4) inches onto the field substrate surface.

F. Surfacing and Finishes:

- 1. Provide and install approved kiln-dried mineral surfacing with dry roller to achieve non-skid surface. Note: surfacing is considered a non-warranty maintenance item, and will require re-application periodically.
- 2. Broadcast specified and approved sand or aggregate in excess into a bonding coat application of Membrane Manufacturer's approved methyl methacrylate-based aggregate coating system applied over clean, cured membrane at the manufacturer's recommended application rate.
- 3. Aggregate shall be applied to excess to obtain uniform and full coverage.
- 4. Following minimum 2 hour cure time remove loose/un-embedded mineral aggregate by blowing with oil-free compressed air or with a vacuum. Re-broadcast clean mineral aggregate as required to provide full embedment and coverage of membrane.
- 5. Seal aggregate surface with a sealing coat application of Membrane Manufacturer's approved aggregate coating, applied at the manufacturer's

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recommended application rate. After completion of surfacing, avoid any traffic for a minimum of three (3) hours to allow for surfacing to cure.

- G. Temporary Closures & Waterstops: Contractor shall be responsible to ensure that moisture does not damage any completed section of the new waterproofing system. Completion of flashings, terminations, and temporary closures shall be completed as required to provide a watertight condition. All temporary closures shall be made as recommended or required by the roofing system manufacturer.
- H. Protection: Upon completion of roofing and flashings (including all associated work), institute appropriate procedures for surveillance and protection of roofing during remainder of construction period. Protect all areas where roofing has been installed.
- I. Closeout:
  - 1. Correction of Work: Work that does not conform to specified requirements including tolerances, slopes, and finishes shall be corrected and/or replaced. Any deficiencies of roofing system application, termination and/or protection as noted during the roofing system manufacturer's inspections shall be corrected and/or replaced at Contractor's expense.
  - 2. Clean-Up: Site clean-up, including both interior and exterior building areas that have been affected by construction, shall be restored to pre-construction condition.

#### PART 4 – PAYMENT

Payment will not be made directly but shall be included in the Lump Sum Bid of which it is a part. Such payment shall represent full compensation for furnishing all materials, labor, tools, equipment and incidentals required to complete the work.

END OF SECTION

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## SECTION 08900

### LOUVERS AND VENTS

#### PART 1 – GENERAL

##### 1.1 GENERAL REQUIREMENTS

- A. Description. Furnishing of all labor, materials, tools and equipment necessary for installation of the penthouse gravity ventilator covered in this section and the Project Drawings, and as needed for a complete and proper installation.

##### 1.2 SUBMITTALS

- A. Product Data: Include manufacturer's product specifications, technical support data, installation and maintenance recommendations and standard details, including flashing methods, hardware and accessories.
- B. Shop drawings shall indicate materials, thicknesses, profiles, accessories, connection and dimensions.
- C. Calculations: Submit a minimum of 2 sets of calculations stamped by a structural engineer licensed in the State of Hawaii.
- D. Manufacturer to provide samples upon request; sized to represent material adequately.
- E. Warranty: Submit executed copy of ventilator assembly Manufacturer's Warranty.

##### 1.3 FABRICATOR QUALIFICATIONS

- A. A firm experienced in producing metal fabrications similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units within the project schedule.
- B. Welding: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1, "Structural Welding Code – Steel."
  - 2. AWS D1.2, "Structural Welding Code – Aluminum."
  - 3. AWS D1.6, "Structural Welding Code – Stainless Steel."
- C. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

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#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to Project site in manufacturer's original, sealed and labeled packaging with manufacturer's name, product brand name and type, date of manufacture, and directions for storing.
- B. Storage: Store materials in a dry area indoors, protected from damage and in accordance with manufacturer's instructions for protection of units.
- C. Handle all materials in such a manner as to preclude damage to finish or unit.

#### 1.5 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by the manufacturer.
- B. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.
- C. The Contractor shall verify that other trades with related work are complete before installing pre-fabricated component(s). Mounting surfaces shall be straight and secure; substrates shall be of proper width. Refer to construction documents, shop drawings, and manufacturer's installation instructions.

#### 1.6 DESIGN PERFORMANCE

- A. Design of ventilator frame structure and connection to the roof slab/curb shall meet the wind load requirements per the 2006 edition of the International Building Code.

#### 1.7 WARRANTY

- A. The warranty of this equipment is to be free from defects in material and workmanship for a period of one year from the purchase date. Any units or parts which prove defective during the warranty period will be replaced at the Manufacturer's option when returned to Manufacturer, transportation prepaid.

### PART 2 – MATERIALS

#### 2.1 FABRICATED GRAVITY VENTILATOR

- A. Description and Features: The ventilator is low silhouette for intake applications with natural gravity or negative pressure system.
- B. Hood and Base:

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1. Shall be aluminum, constructed of precision formed, arched panels with interlocking seams. Vertical end panels are fully locked into hood end panels. Curb cap has pre-punched mounting holes for installation.

C. Bird Screen:

1. Constructed of ½” aluminum mesh, and mounted horizontally across the intake area of the hood.

D. Insect Screen:

1. Constructed of fine mesh aluminum, fitted above the bird screen, but not over the top of the throat.

E. Filters

1. Shall be mounted in open end racks for easy removal.
2. Washable 2-inch aluminum mesh designed to remove contaminants from the air.

F. Manufacturers: Examples of manufacturers meeting the above requirements:

1. Greenheck – Model “GRSI” ([www.greenheck.com](http://www.greenheck.com)), Schofield, Wisconsin, 54476. Phone: (715) 359-6171.
2. Approved equal

G. Fasteners: Provide stainless steel, epoxy adhesive, or other materials warranted by the manufacturer to be non-corrosive and compatible with trim, hardware, anchors and other components of louver unit. Where fasteners screw-anchor into frame members less than 0.125 inches thick, reinforce the interior to receive screw threads, or provide standard, non-corrosive, pressed-in, splined grommet nuts.

H. Anchors, Clips and Accessories: Fabricate anchors, clips and accessories of non-magnetic stainless steel. Anchors, clips and louver accessories fabricated of hot-dip zinc coated steel or iron may be used for concealed work.

## 2.2 FABRICATION REQUIREMENTS

- A. Fabricate to minimize field adjustments, splicing, mechanical joints and field assembly nuts.
- B. Preassemble units to greatest extent possible and disassemble as necessary for shipping and handling.
- C. Clearly mark units for reassembly and coordinated installation.

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D. Join frame-to-frame connections by welding in shop, and frame and lade members to one another by riveting, except where field bolted/screwed connections between frame members are necessary due to size of louver.

E. Maintain equal blade spacing to produce uniform appearance.

### PART 3 – EXECUTION

#### 3.1 INSTALLATION

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal fabrications to in-place construction. Include threaded fasteners for concrete inserts, through-bolts, and other connectors. For pre-fabricated items secure as recommended by Manufacturer.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

C. Provide items that are to be built into concrete, or similar construction in a timely manner, not to delay progress of construction.

D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are designed to be bolted or screw field connections.

### PART 4 – PAYMENT

No separate payment for will be made; compensation for such work shall be deemed to be included in the Lump Sum Bid for the item of which it is a part.

END OF SECTION

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## SECTION 09900

### RESERVOIR PAINTING

#### PART 1 – GENERAL

##### 1.1 GENERAL REQUIREMENTS

- A. Description. This item of work shall include the furnishing of labor, materials, tools, and equipment necessary for completing exterior painting of surfaces in accordance with Section 303.27 of the Water System Standards, dated 2002, and as supplemented hereinafter, and applicable to this project. Items to be painted shall include all new work with a painted surface and as indicated.
- B. Work on Other Sections: Shop coats on ferrous metals.
- C. No paint finish is required on the following: Nonferrous metals, fiber reinforced plastic, plastic lumber, unless specifically noted on Drawings.
- D. Packages and Labels: Deliver materials in original containers, manufacturer's labels thereon. Do not open container or remove labels until Engineer has approved material.
- E. Storage: Store paint materials out of direct sunlight and as recommended by the manufacturer. Do not store containers exposed to weather. Storage place shall be a location agreed upon by the Contractor and Engineer.
- F. Fire Protection: Contractor shall exercise extraordinary care to prevent fire. Keep rubbing cloths and oily rags in tightly closed metal containers.
- G. Protection and Cleaning: Protect adjacent work with drop cloths. Clean paint splatters and stains from completed surfaces.
- H. Begin painting only after paint manufacturer's representative has approved the surface for painting. The work shall be performed in strict conformance with the paint manufacturer's direction.

##### 1.2 SUBMITTALS

- A. Submit six (6) copies of the following to the Department of Land and Natural Resources for approval. No materials shall be ordered prior to the Department of Land and Natural Resources' approval.
  - 1. Submit complete and detailed list of materials proposed for use, their MSDS sheets and certification the proposed products meet the project requirements.

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2. Letter from paint manufacturer, stating that proposed materials are the best of their respective kinds and suitable for the intended purpose and project conditions.
3. Samples: Submit six (6) sets of color samples approximately 8 ½" x 11" in size for each proposed color and texture for approval by the Engineer before proceeding with the work and make as many samples as required to secure desired results.

### 1.3 QUALITY ASSURANCE

- A. The Painting Contractor must be capable of performing the various items of work as specified. If required by the Engineer, the Painting Contractor shall furnish a statement covering experience on similar work, a list of machinery, plan and other equipment available for the proposed work, and a financial statement, including a complete statement of the Paint Contractor's financial ability and experience in performing similar painting and coating work. The Painting Contractor shall have a minimum of five (5) years practical experience and a successful history in the application of the specified products to concrete surfaces. Upon request, the Painting Contractor shall substantiate this requirement by furnishing a list of references, which shall include jobs of similar nature.
- B. The painting contractor shall coordinate the presence of the manufacturer's representative and shall provide the manufacturer's representative with a schedule of his work. The schedule shall be designed in such a way as to meet project requirements.
- C. Paint manufacturer's representative is required to be on-site as often as the representative deems necessary to assure the painted surfaces and the painting are in accordance with the manufacturer's directions and in no way negate the manufacturer's warranty.
- D. Paint shall not contain any materials determined hazardous, such as lead.

### 1.4 PROJECT CONDITIONS

- A. Contractor is responsible for defective work from any cause, including unsuitable and improperly prepared surface, or presence of vapor drive not properly addressed. Prime all surfaces as required by finish coat manufacturer.
- B. Protection: Before applying paint, remove or provide ample protection for hardware, plates, light fixtures, and similar items. Replace upon completion. Employ skilled craftsmen for removing and reinstalling above items. Protect surfaces not to be painted and remove any unintended paint immediately.
- C. Application of the first coat of paint constitutes the Contractor's acceptance of the surfaces and the responsibility for it, including the removal of hazardous materials.

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## PART 2 – MATERIALS

### 2.1 MATERIALS

- A. Material List: Submit complete and detailed list of materials proposed for use on the work. Include letter from manufacturer, stating that materials are the best of their respective kinds and suitable for the intended purpose.
- B. Paint Schedule: Schedule for the various substrates shall be in accordance with Division 400, Section 402 – Approved Material List of the Water System Standards, dated 2002, and approved amendments.
- C. Colors shall be as selected by the Department of Land and Natural Resources for the following items with paint finishes:
  - 1. Exposed pipe (except copper), fittings, valves and equipment.
  - 2. Electrical work and conduits.
  - 3. Potable water piping and components.
- D. The finish coat for exterior of reservoir shall be #873 Alligator Pear, ICI Paints, Leaf #96 or approved equal color scheme. The first coat of finish paint shall be a different shade from the final finish coat providing visual assurance all surfaces has two coats of the finish paint.
- E. The following surfaces shall not be painted and shall be protected during the surface preparation and painting of adjacent areas:
  - 1. Stainless Steel
  - 2. Metal Letters
  - 3. Nameplates
  - 4. Grease Fittings
  - 5. Brass and Copper
  - 6. Buried Pipe, unless specifically required in the piping specifications

## PART 3 – EXECUTION

### 3.1 SURFACE PREPARATION

- A. All surfaces must conform to manufacturer's recommendations and to the satisfaction of the Engineer. All surfaces of different material are to be considered separately and

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each are to be treated as separate cases prepared as recommended by the manufacturer.

- B. All metal surfaces to be painted shall be dry, clean and free from dirt, oil, grease, rust, scale or other foreign matters.
- C. Concrete surfaces shall be at least one month old, dry, clean, and free of dust, plaster, oils, grease, waxes, curing compounds, and other foreign matter.

### 3.2 MIXING AND THINNING

- A. Proprietary products will not negate any warranty of the paint. Mix and thin in strict accordance with manufacturer's printed directions under direction of manufacturer's representative.
- B. Other Materials: Mix and thin in accordance with standard practice and only as approved by the paint manufacturer.

### 3.3 APPLICATION

- A. Workmanship: Highest quality, by skilled workers, in accordance with best trade practices. Spread material evenly, without runs or sags. Cut sharp lines against other materials. Vary shades of successive coats to prevent skipping. Prime backs of frames and trim with sealer or paint. Allow ample time between coats for thorough drying. Rate of primer and paint application shall be in strict conformance with manufacturer's direction.
- B. Defective Work: Contractor is responsible whatever the cause; refinishing work will be at no additional cost to the owner. Repair work that is damaged during construction. Leave painted surfaces in first class condition at time of final acceptance.
- C. Painting shall be at rates of application per layer in strict accordance with the manufacturer's direction to achieve the total dry film thickness specified.
- D. Application of paint system components shall be by brush or rollers only, unless otherwise approved by Engineer.

### 3.4 CLEAN-UP

- A. Clean all misplaced paint and remove all excess paint, materials and equipment from the job site upon completion.
- B. Leave premises neat and clean in a manner acceptable to the Engineer.

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#### PART 4 – PAYMENT

Payment will not be made directly but shall be included in the Lump Sum Bid of which it is a part. Such payment shall represent full compensation for furnishing all materials, labor, tools, equipment and incidentals required to complete the work.

END OF SECTION

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## SECTION 13600

### RESERVOIR EXPANSION AND CONSTRUCTION JOINTS

#### PART 1 – GENERAL

##### 1.1 GENERAL REQUIREMENTS

- A. Description. Furnish of all labor, materials, tools and equipment necessary to complete the reservoir expansion and construction joints installation.

##### 1.2 SUBMITTALS

- A. Furnish certification from manufacturers stating the submitted material meets all the requirements specified herein. The Engineer, at his option, may take samples of any materials and have them tested by an independent testing laboratory to verify their compliance with these Specifications. All such costs shall be borne by the Department of Land and Natural Resources. If any materials should fail to meet these Specifications, all costs for further testing of the replacement material shall be borne by the Contractor.

#### PART 2 – MATERIALS

##### 2.1 WATERSTOPS

- A. Waterstops shall meet the requirements of Water Systems Standards, Section 212.09, with the following revisions and additions and the size and profile specified on the Drawings.

- B. Materials:

- 1. Thermoplastic Vulcanizate (TPV)
  - 2. Virgin Polyvinyl Chloride (PVC)
  - 3. No reclaimed PVC shall be used in the compound.

- C. The finished waterstop material shall meet the following minimum requirements:

- 1. Tensile strength: 2,000 psi (ASTM D 412)
  - 2. Ultimate elongation: 350% (ASTM D 412)
  - 3. Shore hardness: 75 min. (ASTM D 2240)
  - 4. Specific gravity: 0.95 min. (ASTM D 792)
  - 5. Stiffness in flexure: 600 psi (ASTM D 747)

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6. Cold brittleness point: 35°F max. (ASTM D 746)
  7. Water absorption (48 hrs.): 0.320% max. (ASTM D 570)
  8. Tear resistance: 275 lb./in. (ASTM D 624)
- D. VINYLEX, 3400 Tree Court Industrial Blvd., St. Louis, MO 63122 (Phone 800-325-3602) and GREENSTREAK PLASTIC PRODUCTS, Box 7139, St. Louis, MO 63177 (phone 314-225-9400) are two of several suppliers who can furnish waterstops meeting these requirements. Approved equal materials may also be used.
- E. Waterstop intersection joints shall be prefabricated with a 12-inch minimum length from the joint.

## 2.2 JOINT SEALERS

- A. Joints, not requiring waterstops or when so indicated on the Drawings, shall be sealed with a mastic joint sealer material of uniform, stiff consistency that does not contain solvents.
- B. The mastic shall tenaciously adhere to primed concrete surfaces, shall remain permanently mastic and shall not contaminate potable water.
- C. The material shall be of a type that will effectively and permanently seal joints subject to movements in concrete.
- D. The mastic joint sealer shall be an acceptable two part, self-leveling (or gun grade), non-staining, polyurethane elastomeric sealant that cures at ambient temperature. Acceptable sealants shall conform to ASTM C 920 or Federal Specification TT S 00227E.
- E. For sloping joints, vertical joints and overhead horizontal joints, only "non-sag" compounds shall be used; all such compounds shall conform to the requirements of ANSI/ASTM C 920 Class 12-1/2, or Federal Specification TT-S-0027 E (3), Type II.
- F. For plane horizontal joints, the self-leveling compounds which meet the requirements of ANSI/ASTM C 920 Class 25, or Federal Specification TT-S-0027 E (3), Type I shall be used. For joints subject to either pedestrian or vehicular traffic, a compound providing non-tracking characteristics, and having a Shore "A" hardness range of 25 to 35, shall be used.
- G. Primer materials, if recommended by the sealant manufacturer, shall conform to the printed recommendations of the sealant manufacturer.
- H. Acceptable polyurethane materials are PSI-270 RESERVOIR SEALANT, as manufactured by POLYMERIC SYSTEMS, INC., Phoenixville, PA (610-935-1170), SIKAFLEX/2C POLYURETHANE ELASTOMERIC SEALANT, as manufactured

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by SIKA CHEMICAL CORP., Santa Fe Springs, CA (310-941-0231) and SELECT SEAL U-227 RESERVOIR GRADE, as manufactured by SELECT PRODUCTS CORP., Costa Mesa, CA (714-429-0808), or approved equal.

### 2.3 PREFORMED JOINT FILLER

- A. Preformed joint filler material shall be of the preformed non-extruding type joint filler constructed of cellular neoprene sponge rubber or polyurethane of firm texture. Bituminous fiber type will not be permitted. All non-extruding and resilient-type preformed expansion joint fillers shall conform to the requirements and tests set forth in ASTM D 1752 for Type I, except as otherwise specified herein.

### 2.4 BACKING ROD

- A. Backing rod shall be an extruded closed-cell, polyethylene foam rod. The material shall be compatible with the joint sealant material used and shall have a tensile strength of not less than 40 psi and a compression deflection of approximately 25 percent at 8 psi. The rod shall be 1/8-inch larger in diameter than the joint width except that a one-inch diameter rod shall be used for a 3/4-inch wide joint.

### 2.5 BOND BREAKER

- 1. Bond breaker shall be SUPER BOND BREAKER WATER BASE as manufactured by Burke Company, San Mateo, California; SELECT EMULSION CURE 309, as distributed by Select Products Co., Costa Mesa, CA (clear or white pigmented) or equivalent. Fugitive dye may be used in bondbreakers if recommended by manufacturer.

## PART 3 – EXECUTION

### 3.1 WATERSTOP INSTALLATION

- A. The waterstop shall be correctly positioned in the forms with the center of the waterstop centered on the joint.
- B. In cases where preformed expansion joint material is used in conjunction with the waterstop, allowance shall be made for equal waterstop embedment on each side in the concrete.
- C. Waterstop shall be held in place in the forms by use of a split form or other approved method that will positively hold the waterstop in the correct position and to the correct alignment.
- D. All waterstop intersection joints shall be welded in the shop and shipped to the project site.
- E. Field Joints

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1. Field joints shall be restricted to properly aligned, straight butt joints only.
  2. Use only recommended splicing tool for field joints of waterstop.
  3. Centerbulbs shall be compressed or closed when welding to non-centerbulb type or edge.
- F. Horizontal waterstops shall be bent up during placing of concrete until the concrete has been brought to the level of the waterstop; additional concrete shall then be placed over the waterstop, after which the concrete shall be thoroughly vibrated.
- G. All horizontal and vertical waterstops, which are not accessible during pouring, shall be tied off in two directions every 12 inches to prevent bending over during concrete placement or consolidation.
- H. A hog ring or nail may be driven through both ends of the waterstop to facilitate placing and tying of waterstops to reinforcing steel forms or form ties.
- I. All waterstops shall be properly spliced and joints shall be checked for strength and pinholes after splicing.
- J. Splices shall be strong enough to develop a pulling force of 75 percent of the waterstop strength and shall be watertight.
- K. Ends of the radial waterstop in the floor slab joints shall be connected to the circumferential waterstop in the floor to wall footing joint.

### 3.2 INSTALLATION OF JOINT SEALER

- A. Joint sealed areas shall be sandblasted or roughened and blown clean of dust and sand with compressed air before the material may be applied.
- B. Joints shall be primed (if required) prior to installing the joint sealer, install bond breaker tape to bottom of joint. Sealant shall be applied in accordance with the manufacturer's recommendations.

## PART 4 – PAYMENT

Payment will not be made directly but shall be included in the Lump Sum Bid of which it is a part. Such payment shall represent full compensation for furnishing all materials, labor, tools, equipment and incidentals required to complete the work.

## END OF SECTION

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## SECTION 13700

### RESERVOIR WALL, BASE, AND TOP JOINTS

#### PART 1 – GENERAL

##### 1.1 GENERAL REQUIREMENTS

- A. Description. Furnish of all labor, materials, tools and equipment necessary to complete the reservoir wall, base, and top joints

##### 1.2 SUBMITTALS

- A. The Contractor shall provide the Engineer a 2-foot minimum length of each of the closed cell neoprene pads and the neoprene bearing pads in order to test the pads for compliance with these Specifications.
- B. Furnish certified mill certificates showing that the material meets all of the requirements specified here in. The Engineer, at the Department of Land and Natural Resources option, may take samples of any materials and have them tested by an independent testing laboratory to verify their compliance with these Specifications. All such costs shall be borne by the Department of Land and Natural Resources. If any materials should fail to meet these Specifications, all costs for further testing of the replacement material shall be borne by the Contractor.
- C. For manufactured items submit product data sheets indicating the properties of the proposed item meet the requirements of these specifications.

#### PART 2 – MATERIALS

##### 2.1 WATERSTOPS

- A. Waterstops shall conform to requirements in Section 13600 - RESERVOIR EXPANSION AND CONSTRUCTION JOINTS. The size and location of the waterstop shall be as shown on the Drawings.

##### 2.2 NEOPRENE BEARING PADS

- A. Neoprene pads shall be of dimensions and hardness shown on the Drawings and shall be made by an approved manufacturer.
- B. The material for 40 durometer neoprene pads shall conform to ASTM D 2000 M2BC414A14C12F17 and the material for 30 durometer neoprene pads shall conform to ASTM D 2000 M2BC310A14C12F17.
- C. Unless otherwise specified on the Drawings, neoprene pads shall be of 40 durometers.

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- D. DACOM INDUSTRIES CO., 10661 N. Lombard, Portland, OR 97203 (Phone 503 978 0801 and WEST AMERICAN RUBBER COMPANY, INC. (Phone: 714-532-3355) or approved equal, are two of several suppliers who can furnish neoprene pads meeting these requirements.

## 2.3 CLOSED CELL NEOPRENE FILLER PADS

- A. Closed cell neoprene pads shall be used as a filler material in the flexible joints between the wall and wall footing and between the wall and roof connection in the areas not taken up by the solid neoprene bearing pads and waterstops.
- B. The materials shall be medium grade closed cell neoprene conforming to 2C3 of ASTM D 1056-00 or 2A3 based on ASTM D 1056-85 and as further specified here-in and on the Drawings.
1. Compression deflection: 9-13 PSI
  2. Density: 18-28 PCF
  3. Water absorption by weight: 0.5 lbs/ft<sup>2</sup>
  4. Temperature range:
  5. Low (flex without cracking): -30°F
  6. High continuous: 150°F
  7. High intermittent: 200°F
  8. Heat aging (7 days @ 158°F): 5% max. (7 days at 158°F)
  9. Tensile strength: 100 PSI min.
  10. Elongation: 170% min.
  11. Resilience: 20%-40% (bayshore % rebound average 1/2" thickness @ 72°F)
- C. HANNA RUBBER CO. "R-431-N", or CYPRESS SPONGE 431N or 423N, or approved equal, are acceptable materials.

## 2.4 SOFT MASTIC

- A. Self-leveling soft mastic shall be installed in all voids and cavities around bearing pads, waterstops and seismic cable sleeves. Such material shall be installed with a consistency that will not adversely affect the quality of rubber or neoprene materials.

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- B. SIKAFLEX 1A, as manufactured by Sika Corporation or SELECT SEAL U-230, as manufactured by Select Products Company, or approved equal, are acceptable materials.

## PART 3 – EXECUTION

### 3.1 WATERSTOP INSTALLATION

- A. Waterstops shall be continuous and shall be installed where shown. The method of installation shall be as specified in Section 13600 – RESERVOIR EXPANSION AND CONSTRUCTION JOINTS.

### 3.2 BEARING AND NEOPRENE FILLER PADS

- A. Bearing and filler pads shall be installed as indicated on the Drawings.
- B. Bearing and filler pads shall be glued to the concrete with an approved rubber cement material to prevent uplift of the pads during placement of concrete.
- C. In addition, all pads shall be held down with approved plastic shim plates or ‘adobes’ placed under the reinforcing steel as shown.
- D. Nailing down pads will not be permitted.
- E. All voids and cavities between bearing and filler pads, waterstop and seismic cable sleeves, irrespective of whether these voids are large or small, shall be filled with a soft mastic.
- F. Closed cell neoprene shall be ordered at least 1/4 inch wider than theoretically required to facilitate placing and to reduce development of voids between filler pads, bearing pads and waterstops.
- G. Contractor's workmanship shall be such that no cement grout or concrete seepage will occur through the bearing and filler pad area resulting in a restraint of radial wall movements.
- H. Neoprene bearing pads and one or more closed cell neoprene pads are required between the top of the wall and the underside of the roof. Secure pads as described above in item #2. Trim closed cell neoprene pads as required to fit around seismic tubes at top of wall. Any void areas between such pads shall be filled with soft mastic to prevent any mortar from the roof pour to come into contact with the wall top.

#### PART 4 – PAYMENT

Payment will not be made directly but shall be included in the Lump Sum Bid of which it is a part. Such payment shall represent full compensation for furnishing all materials, labor, tools, equipment and incidentals required to complete the work.

END OF SECTION

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## DIVISION 16 - ELECTRICAL

### SECTION 16000 - GENERAL ELECTRICAL REQUIREMENTS

#### PART 1 - GENERAL

##### 1.1 GENERAL REQUIREMENTS

- A. As specified in Section 01019.
- B. Electrical Work: Provide all articles, materials, equipment operators, systems and services specified herein and on the Drawings and as normally required by accepted industry standard practices, including all labor taxes, fees, insurance, warranties and incidentals required to complete all electrical work.
- C. In general, the following work is included:
  - 1. Provide, complete and in place, electrical and communication systems as indicated in the Drawings and specified herein. Provide, complete and in place, exterior electrical, communication, and lighting systems.
  - 2. Provide saw cutting (where required), excavation, shoring, bracing, suitable backfill material, concrete encasement, backfilling, compacting, ac patching (where required) and concrete patching (where required) for complete duct system installation.
  - 3. Coordinate work with Hawaiian Electric Company, Hawaiian Telcom, the State of Hawaii, and the County of Hawaii electrical inspectors.
- D. Furnish required submittals and samples, operations and maintenance manuals, and "As-built" Drawings.
- E. Coordinate work with other trades to avoid omissions and overlapping of responsibilities.
- F. Apply for, obtain and pay for all County fees, permits, licenses, utility fees, assessments and inspections required for this work.
- G. Pay for all temporary construction and testing power.
- H. Before bidding, visit project site, carefully review each section of the Specifications and all Drawings of this Contract. Verify details, report any error, conflicts or omissions to the Project Engineer at least 10 calendar days before submission of bids for interpretation or clarification. If errors or omissions are not reported, Contractor shall provide necessary work at no additional cost to the Project Engineer to properly complete intent of Specifications and Drawings. By submitting a proposal of the work included in this contract, the Contractor shall be

deemed to have made such examination and to be familiar with and accept all conditions of the job site.

## 1.2 SUMMARY

This Section includes specifications for interior and exterior electrical work.

## 1.3 INTENT OF SPECIFICATIONS AND DRAWINGS

- A. Specifications and Drawings are prepared in abbreviated form and include incomplete sentences. Omission of words or phrases such as “the Contractor shall”, “as shown on the drawings”, “a” and “the” are intentional. Omitted words and phrases shall be provided by inference to form complete sentences.
- B. Specifications and Drawings complement each other and what is specified, scheduled or mentioned on one shall be binding as if called for by both.
- C. Discrepancies and Interpretations:
  - 1. Should the Contractor find any discrepancies in or omissions from any of the documents or be in doubt as to their meaning, he shall advise the Project Engineer who will issue any necessary clarification within a time period which does not disrupt the progress of the work.
  - 2. All interpretation and supplemental instructions will be in the form of a written addendum to the Contract Documents.
  - 3. Should any discrepancies arise from the failure of the Contractor to notify the Project Engineer, the higher quality or larger quantity of item shall prevail. Project Engineer shall make the final interpretation and judgment.
  - 4. In the event of a discrepancy between small scale drawings and large scale details, or between Drawings and Specifications, of which is in violation of any regulations, ordinances, laws or codes, the discrepancy, if known by the Contractor, shall be immediately brought to the attention of the Project Engineer for a decision before proceeding with the particular work involved. Work carried out disregarding these instructions will be subject to removal and replacement at the Contractor's expense.

## 1.4 DEFINITIONS

- A. Provide: “Furnish and install, test and deliver to the Project Engineer in operating and ready to use condition.”
- B. Wiring: “Provide all raceways, junction boxes, conductors, devices, protection equipment, installation of motor controllers (furnished by others) when required, etc., including testing for a complete, operative and ready to use electrical system.”

- C. Equal: "Material, equipment or system, including all necessary labor, modifications and accessories satisfying the requirements of the contract documents, the design intent, and to provide features or have operating characteristics equal or better than that specified."
- D. Complete: "Furnish installation that is operative, tested, and ready to use and which satisfies the intent of the contract documents, including all necessary accessories and modifications."
- E. Contractor: "General Contractor responsible for all work shall assign work to Sub-Contractors. Except where noted, work of this section shall be assigned to the Electrical Sub-Contractor."
- F. HECO: Hawaiian Electric Company
- G. HTCO: Hawaiian Telcom

## 1.5 QUALITY ASSURANCE

- A. Government and Utility Requirements: Comply with all requirements of the State of Hawaii, County of Hawaii, Disability and Communication Access Board (DCAB), and respective utility company rules and regulations.
- B. Specifications are accompanied by architectural, civil, mechanical, landscape, and audio-visual plans of the buildings, site, and diagrammatical electrical plans showing locations of luminaries, standards, outlets, feeder runs, devices and other electrical equipment. Locations are approximate and before installation, Contractor shall study adjacent construction details and make installation in the most logical manner. Prior to installation and at the direction of the Project Engineer, relocate any device, equipment, feeder, or circuit within 10'-0" of the location presently shown without added cost to the Project Engineer.
- C. Prior to start of the rough-in work, verify all dimensions and equipment sizes with the approved shop drawings including equipment furnished by others. Circuits and raceway routes are diagrammatic and may be altered in any logical manner. However, all changes from the contract documents shall be subject to review and acceptance of the Project Engineer and indicated on the "As-built" Drawings.
- D. Feeders and branch circuits for equipment furnished by others were sized for the anticipate equipment. Verify electrical requirements of all equipment furnished by others prior to rough in and prior to ordering of the electrical distribution equipment. Re-size affected feeders and branch circuits at no additional cost to the Project Engineer.
- E. Materials and Equipment: Materials and equipment shall conform to requirements of applicable technical specification sections, publications specified therein and shall be as shown on the drawings. Materials and equipment shall be new and shall be the product of manufacturers regularly engaged in the manufacture of such products.



All items shall essentially duplicate materials and equipment which have been in satisfactory use at least two years prior to bid opening and shall be supported by a service organization that is located reasonably close to the site of installation.

F. Substitutions:

1. Where items are specified by manufacturer's name or catalog number, substitutions require written permission by the Project Engineer prior to bidding.
2. Samples of proposed substitute items may be required and shall be submitted by the Contractor at his expense as soon as practicable after they are requested.
3. Burden of proof of equality of proposed substitutions will be the responsibility of the Contractor. Submittals shall be sufficiently detailed to permit evaluation of the proposed items. Inadequacy of submittals shall be sufficient cause to reject a proposed substitution.
4. All prospective bidders must submit descriptive information on proposed material for pre-bidding acceptance where an item is detailed but no manufacturer is named.
5. Costs to review any contractor submitted value engineering change proposals shall be paid by the Contractor.

G. Prevention of Corrosion: All metallic materials shall be protected against corrosion. Exposed metallic parts of equipment, apparatus, devices, mounting hardware, and fasteners that are provided in damp, wet, or corrosive areas shall be constructed from 316 or 316L stainless steel. All such parts as boxes, bodies, fittings, guards and miscellaneous parts shall be constructed of 316 or 316L stainless steel. The Contractor shall not join dissimilar metals that will result in deterioration due to galvanic corrosion.

1.6 DEPARTURES

- A. Departures resulting from the substitution of materials or systems shall be accompanied by appropriate changes in all affected work of every trade and shall include stamped and signed drawings by a licensed engineer for any portion of the project requiring re-design. Such changes shall be done at no increase to the contract amount and shall be the responsibility of the Sub-Contractor or supplier responsible for the departures. Changes proposed by the Contractor shall be based on a system approach and may be allowed if implemented without decrease in quality, performance and operations, increase in utility costs or adverse effect on the available physical space to install the equipment. Such departures shall be submitted and noted in shop drawings for review and acceptance by the Project Engineer. Departures initiated by other trades, requiring changes in the electrical system as well as other systems, shall be accompanied by appropriate changes to all

affected work of every trade, at no increase in contract amount. Submission for departure shall be as follows:

EXAMPLE:

<u>Item</u>	<u>Manufacturer and Catalog Number Specified</u>	<u>Substitute Manufacturer and Catalog Number</u>
Cable	John Doe - No. 3200	King - No. 2200

- B. The General Contractor shall be responsible to coordinate, approve and select systems that do not impose unaccounted for impacts on the electrical work. It shall be understood that after the award of contract, all departures having electrical impact, unless otherwise noted, have been reviewed and approved by the General Contractor.

## 1.7 SUBMITTALS

- A. Submit in accordance with Section 01300 - SUBMITTALS. All submittals shall be reviewed and approved by the general contractor and the electrical contractor. Partial submittals or submittals lacking the general contractor's and electrical contractor's approvals will not be acceptable. Submit for approval six (6) complete sets of submittals as described below. Annotate descriptive data to show the specific model, type, option, and size of each item the Contractor proposes to furnish. Do not commence work until each system, including all the various components, have been approved. The Project Engineer will review and approve all submittals. Before the materials are ordered or the work is commenced the shop drawings must be approved. All submittals shall be submitted to and reviewed by the LEED Administrator as necessary for the LEED documentation process.
- B. List of Materials and Equipment: Submit in accordance with Section 01300 - SUBMITTALS. These lists shall include manufacturer's names and material or equipment identification such as styles, types, or catalog numbers to permit ready and complete identification. Original catalog cuts or brochures shall be provided. Scanned or photocopied submittals will be rejected without review.
- C. Product Data: Shall be sufficiently comprehensive and detailed to permit evaluations, otherwise the item may be rejected, and shall include, as applicable, the following:
1. Original catalog cuts or brochures shall be provided. Scanned or photocopied submittals will be rejected without review.
  2. Each submittal shall contain an itemized list of each item being submitted. Each item shall be identified with the complete manufacturer's ordering number including all options.
  3. Dimension outlines of all enclosures.

4. Dimension drawings of components such as switchboard, motor control center, panelboards, transformers, enclosed circuit breakers, safety disconnect switches, inverters, and generators.
  5. Scaled drawings showing the layouts and arrangement of equipment in all electrical rooms, telecom rooms, and generator rooms.
  6. Operating and electrical characteristics including interrupting ratings and impedances.
- D. Certificate of Compliance: Where required by the section specifying the equipment, the Contractor shall submit six (6) copies of certificates of compliance in accordance with the requirements of the GENERAL REQUIREMENTS. The certificates shall include but not be limited to factory test reports.
- E. Installation, Operation and Maintenance Data: Six (6) copies of installation, operation and maintenance data shall be submitted for equipment specified to require such data. The data shall be in the form of manuals and shall indicate instructions for operating, maintaining, repairing, recommended inspection points, periods for inspection, and all related spare parts in a practical, complete and comprehensive manner. The information shall be arranged in a logical, orderly sequence, including a general description of the equipment and significant technical characteristics.

Test, adjustment and calibration information shall be furnished and identified to specific equipment. The installation, operation and maintenance data shall be as required by the General Requirements.

- F. Acceptance Requirements: Acceptance for material and equipment will be based on manufacturer's published data. Where materials or equipment are specified to be constructed and tested, or both, in accordance with the standards of the National Electrical Manufacturers Association (NEMA) or the American National Standards Institute (ANSI), the Contractor shall submit proof that the items furnished under this section of the specifications conform to such requirements. A certification or published catalog specification data statement to the effect that the item is in accordance with the referenced NEMA standard by a company listed as a member company of NEMA for the section whose standards cover the item under construction, will be acceptable as sufficient evidence that the item conforms to the requirements of the National Electrical Manufacturers Association. A manufacturer's statement indicating complete compliance of each item with the applicable NEMA, ANSI or other commercial standard specified shall be submitted and will be acceptable proof of compliance. Conformance with the agency requirements does not relieve the item from complying with any other requirements of the specifications.
- G. Nameplates:
1. General: In addition to standard manufacturer's nameplate, permanent corrosion resistant nameplates shall be provided for each enclosed circuit

breaker, safety switch, panelboard, lighting contactor, inverter, telecom junction box, and other major pieces of equipment. Nameplates shall designate the function of the equipment for which they are used. The designation shall be submitted for review and acceptance with the shop drawings.

2. Material and Lettering: 1/16" thick, laminated plastic, black-white-black. Nameplate lettering shall be 1/4" high upper-case.
3. Fastening: Nameplates shall be fastened stainless steel (316) screws.
4. Hand lettering or stick-on embossed marking tape is not acceptable.
5. Provide laminated tape labeling for all new receptacles on coverplates. Identify associated panel name and circuit number.

#### H. Labels

1. Provide labels as required by the latest version of the National Electrical Code adopted by the County or City & County.
2. The labels shall be designed according to the following standards:
  - a. UL969 – Standard for Marking and Labeling Systems.
  - b. ANSI Z535.4 – Product Safety Signs and Labels.
  - c. NFPA 70 (National Electric Code) – Article 110.16.
  - d. NFPA 70E – Section 130.
3. Labels shall be provided for, but not limited to:
  - a. Available fault currents at the service equipment per 2017 NEC 110.24(A).
  - b. Arc Flash warning labels shall be provided per 2014 NEC 110.16 and 2015 NFPA-70E 130.5. The contractor shall obtain all information required for the calculations, perform the calculations, and provide the labels at no additional cost.
  - c. Source and location of feeder serving switchboards and panelboards per NEC 408.4(B).
  - d. Method utilized for conductor identification per 2017 NEC 210.5(C).

- e. All telecommunication, telephone, data, and signal cables.
  - 4. Label materials shall be provided similar to nameplates except that labels for wires, conductors, and cables shall be of the printed tape type.
  - I. Factory Tests and Inspection:
    - 1. The equipment furnished shall be inspected mechanically and electrically, and all manufacturers' routine factory tests shall be performed to verify conformance with the specified requirements. The test equipment and test methods shall conform to the requirements of standards specified. The contract price shall include cost of performing all tests.
    - 2. The Contractor shall furnish, at time of equipment delivery, six (6) certified copies of all test results.
  - J. Equipment Guarantees: Installation shall be complete in every detail and ready for use. Any item furnished or provided by the Contractor developing defects within one (1) year after final acceptance by the Project Engineer shall be replaced by materials, apparatus and parts including installation labor costs to make such defective portion of the completed system conform to the true intent and meaning of the drawings and specifications, without additional cost to the Project Engineer. The Contractor shall guarantee all equipment provided from the date such equipment is accepted by the Project Engineer, against defects in materials, design, performance and workmanship. Guarantees shall be supported by manufacturer's written warranties and shall be signed by an official of the manufacturer's organization. Replacement parts shall be delivered and repairs shall be made promptly upon receipt of notice of failure under normal and proper use and maintenance. All costs of replacement and repair shall be borne by the Contractor provided that a report substantiating such defect or failure to conform to specifications is promptly given to the Contractor.
- 1.8 CODES, REGULATIONS AND STANDARD SPECIFICATIONS
- A. Work shall conform to the Hawaii Revised Statutes, the Ordinances of City and County of Honolulu; the International Conference of Building Officials (ICBO) International Building Code (IBC); and the latest edition of National Electrical Code (NEC).
  - B. Applicable rules, standards and specifications of following associations shall apply to materials, workmanship, and procedures:
    - American National Standards Institute (ANSI)
    - Illuminating Engineering Society of North America (IESNA)
    - National Electrical Manufacturer's Association (NEMA)
    - National Fire Protection Association (NFPA)
    - Underwriters' Laboratories, Inc. (UL)
- 1.9 ACKNOWLEDGEMENT

- A. By bidding on this project and or by providing this work the Contractor acknowledges that:
  - 1. The Designer is not responsible for the means and methods employed by the Contractor and that the Contractor is responsible for his means and methods.
  - 2. The Designer is not responsible for job site and worker safety and that the Contractor is responsible for job site and worker safety.

#### 1.10 WARRANTY

- A. Defective materials and workmanship shall be removed and replaced at no cost to the Project Engineer. For period of one year after acceptance of work by Project Engineer, materials and workmanship developing defects and malfunctions shall be repaired and/or replaced, to conform with intent of the specification and drawings, at no additional cost to the Project Engineer.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

All materials shall be new, except as specifically noted, and shall bear the label of Underwriter's Laboratories, Inc., wherever standards have been established and label service is normally and regularly furnished by the agency. See the respective technical sections for the electrical material specifications.

### PART 3 - EXECUTION

#### 3.1 MATERIALS AND EQUIPMENT PROVIDED BY THE CONTRACTOR

The electrical installation shall be complete and operable and shall conform to the requirements of the contract drawings. The Contractor shall provide all electrical equipment and materials, wiring, supports and such additional parts as are necessary to make the installation complete. All Contractor furnished materials and equipment are subject to review and acceptance by the Project Engineer.

#### 3.2 PROTECTION DURING STORAGE

Store all materials and equipment in a safe manner. Provide weather, dehumidification, and fire protection for all materials. Store all materials above grade to avoid damage by moisture. Cover all materials to avoid damage from sunlight.

#### 3.3 PROTECTION OF WORK IN PROGRESS

All electrical materials and equipment shall be completely protected during installation. Equipment shall be securely protected against physical or chemical damage. In areas exposed to weather, materials unused at the end of each day's work shall be protected by weatherproofed installations. All unprotected conduits shall be sealed to prevent water and foreign debris from entering conduits. Damage to materials and equipment due to Contractor's neglect shall be repaired or replaced by and at the expense of the Contractor.

### 3.4 PROGRESS OF WORK AND COORDINATION

The Contractor shall prepare a schedule identifying the sequence of electrical work. The electrical work shall be coordinated with the work of other Contractors and other trades. The schedule shall be submitted prior to beginning installation and shall be subject to review and acceptance by the Project Engineer.

### 3.5 RULES

The entire electrical installation shall conform to the applicable rules and regulations of the State Fire Code and the standards and publications specified in the technical sections.

### 3.6 COORDINATION

The contract drawings indicate the extent and general location and arrangement of equipment, conduit and wiring. Lighting fixtures, outlets and electrical equipment shall be located so as to avoid interference with architectural, mechanical and structural features. The Project Engineer may request any device, equipment, circuit, or feeder to be relocated within 10'-0" of the location shown on the Drawings before installation is initiated and without increase in contract amount.

### 3.7 WORKMANSHIP

- A. All materials and equipment shall be installed in accordance with printed recommendations of the manufacturer and shall conform to the requirements of the contract drawings. The installation shall be accomplished by workers skilled in this type of work. For actual fabrication, installation and testing of the Electrical Work, use only thoroughly trained and experienced workmen completely familiar with items to be installed and with manufacturers' recommended methods of installation. In acceptance or rejection of installed work no allowance will be made for lack of skill on part of workmen.
- B. Inspection: Skill and competency of workmanship shall be subject to the approval of the State, and the County of Hawaii. The contractor shall open all electrical equipment, cabinets, junction boxes, and devices as required by the inspector for inspection. All equipment shall be de-energized prior to inspection unless voltage and current measurements are required. The Contractor shall be responsible for all electrical and arc flash safety at the project site.

### 3.8 FIELD TESTS

- A. After the installation is completed, and at such time the inspector may direct, the Contractor shall conduct field tests for acceptance by the inspector. When the tests are specified to be performed under the supervision of the equipment manufacturer, the Contractor shall cooperate with the inspector during tests and shall place at the manufacturer's disposal, all assistance, materials and services required to perform such tests. The tests shall be performed in the presence and to the satisfaction of the Project Engineer. The Contractor shall furnish all necessary electric power, fuel, instruments, equipment, and personnel required for the tests and shall pay for all power and fuel.
- B. Insulation Tests: The insulation of all conductors shall be tested with a megger insulation tester. Submit results of tests to the Project Engineer.
- C. Operating Tests: The equipment and systems shall be demonstrated to operate in accordance with the requirements of the technical sections in which the equipment or systems are specified.
- D. Ground Resistance Test: Test ground resistance by three-point method. Results of test shall be submitted to the Project Engineer. Ground Resistance: Ground resistance measurements of each ground rod shall be taken and certified by the Contractor. Upon completion of the project, the Contractor shall submit in writing to the Project Engineer, the measured ground resistance of each ground rod and grounding system, as well as the resistance and soil conditions at the time the measurements were made. Ground resistance measurements shall be made in normally dry weather, not less than 48 hours after rainfall, and with the ground under test isolated from other grounds.
- E. Test all 600 volt class conductors to verify that no short circuits or accidental grounds exist. Make tests using an instrument which applies a voltage of approximately 500 volts to provide a direct reading in resistance, and measure the insulation resistance from phase to phase and phase to neutral. All test results shall be recorded and submitted to the Project Engineer.
- F. Wherever test or inspection reveals faulty materials or installation, Contractor shall take corrective action, at his own expense, repairing or replacing materials or installation as directed. The materials or installation shall then be retested.

END OF SECTION



## SECTION 16050 – ELECTRICAL BASIC MATERIALS AND METHODS

### PART 1 - GENERAL

#### 1.1 GENERAL REQUIREMENTS

As specified in Section 01019.

#### 1.2 SUMMARY

- A. This section provides the specifications for general electrical work. See other specification sections for more detailed specifications related to specific electrical systems.
- B. The Contractor shall furnish all labor, materials, tools, equipment, electricity, fuel, shipping and delivery, and appliances required to provide all Electrical Work, complete, as indicated on the drawings and/or as specified herein. The drawings note various sizes of equipment as determined for basis of design; the electrical work, however, shall be installed to comply with the equipment furnished by the successful supplier and shall be based on the approved shop drawing submittals. The work shall include but not necessarily be limited to, the following:
- C. Complete power distribution system.
- D. Complete general use and special power systems.
- E. Connection and testing of appliances and equipment furnished by others requiring electrical connections.
- F. Before bidding on this work, carefully examine each of the drawings and the site. By submitting a proposal of the work included in this contract, the Contractor shall be deemed to have made such examination and to be familiar with and accept all conditions of the job site.

#### 1.3 SUBMITTALS

- A. Submit in accordance with Section 01300 - SUBMITTALS.
- B. Shop drawings and catalogue cuts for substitute materials shall clearly specify compliance with and/or deviation from specified material. Certification shall not contain statements to imply that the item does not meet requirements specified, such as "as good as"; and "achieve the same end use and results as materials formulated in accordance with the referenced publications". Certifications shall simply state that the item conforms to the requirements specified. Certificates shall be printed on the manufacturer's letterhead and shall be signed by the manufacturer's official authorized to sign certificates of compliance. Review of

shop drawings and catalogue cuts shall not release Contractor from complying with intent of specification and drawings. Partial or incomplete submittals will be returned without review.

- C. Shop Drawings: Submit complete shop drawings and manufacturer's literature for the Project Engineer's review before any work is ordered or fabricated. All submittals shall bare the approval of the general contractor and the electrical contractor. Partial or incomplete submittals or submittals lacking the general contractor's and electrical contractor's approval will be returned without review. Submit in accordance with Section 01300 - SUBMITTALS. Submit manufacturer's literature for the following:

1. Raceways
2. Conductors
3. Metering/Distribution Switchboards
4. Dry-Type Transformer
5. Panelboards
6. Cabinets/Enclosures
7. Devices (Receptacles, switches, etc.)
8. Junction Boxes, Enclosures, and Cabinets
9. Floor Boxes
10. Special Purpose Receptacles
11. Enclosed Circuit Breakers
12. Disconnect Switches
13. Time Switches
14. Nameplates

- D. As-Built Drawings: Submit as-built drawings as specified under Section 01700 - CONTRACT CLOSEOUT.

#### 1.4 GUARANTEE AND CERTIFICATE

Any item of material, apparatus, equipment furnished and installed, or constructed by the Contractor showing defects in design, construction, quality or workmanship within one year from the date of final acceptance by the Project Engineer shall be replaced by such new material, apparatus or parts as may be found necessary to make such defective portion of the installation conform to the true intent and meaning of the specification and/or the drawings. Exceptions shall be fluorescent and incandescent lamps which shall be guaranteed for one half the manufacturer's listed life time. Such repairs or replacement shall be made by the Contractor, free of all expense to the Project Engineer.

#### 1.5 COORDINATION WITH UTILITY COMPANIES AND OTHER TRADES

During bidding and construction, Contractor shall coordinate his work with utilities, and other trades to avoid omissions and overlapping of responsibilities.

#### 1.6 CODES, REGULATIONS AND STANDARD SPECIFICATIONS

- A. Work shall conform to latest edition of National Electrical Code.
- B. Applicable rules, standards and specifications of following associations shall apply to materials and workmanship:

American National Standards Institute (ANSI)  
Illuminating Engineering Society of North America (IESNA)  
National Board of Fire Underwriters (NBFU)  
National Electrical Manufacturer's Association (NEMA)  
National Fire Protection Association (NFPA)  
Underwriters' Laboratories, Inc. (UL)

### PART 2 - PRODUCTS

#### 2.01 MATERIALS

- A. General: All materials shall be new, except as specifically noted, and shall bear the label of Underwriters' Laboratories whenever standards have been established and label service is normally and regularly furnished by the agency.
- B. Raceways:
  - 1. Conduits: Galvanized rigid steel, 3/4" minimum diameter with compression or threaded fittings, respectively. Aluminum conduits shall not be used.
  - 2. Non-Metallic Conduit: PVC Schedule 40 and sunlight-resistant epoxy resin coated fiberglass, wall thickness as indicated (ISO 9001: 2008 certified), 3/4" minimum diameter.

3. Reinforced Thermosetting Resin Conduit: NEMA Standard TC 14, UL 2515 IPS above Ground and 2515A Extra Heavy Wall standards, ISO 9001: 2015 Quality Control Management, Type AG, sunlight resistant, wall thickness as required to provide degree of protection suitable for installation location.
  4. Flexible Conduit: 3/4" minimum, zinc-coated inside and outside; for damp, wet, moist, or corrosive areas -- liquid-tight with factory fittings and UV stabilized PVC jacket.
- C. Conductors: Conductors shall be copper, No. 12 AWG minimum; No. 10 AWG and smaller, solid and round; No. 8 AWG and larger, 7 or 19 strands concentric. All conductors No. 6 and smaller shall be types THW for interior use or RHW for exterior use. All conductors No. 4 AWG and larger shall be type THWN-2 for interior use; or RHW-2 or USE-2 for exterior use. Conductors used for fire alarm, sound system, and control wiring may be sized according to the system manufacturer based on their load and voltage drop calculations and code requirements. Conductors used to serve critical operations power systems (power systems for facilities or parts of facilities that require continuous operations for reasons of public safety, emergency management, national security, or business continuity) including but not limited to emergency power, HVAC, fire alarm, security, telecommunications, and signaling shall be a listed 2-hour electrical circuit protective system. Conductors installed on roof tops and exposed to sunlight shall be derated per NEC Table 310.15(B)(2)(b) or shall be type XHHW-2. Conduit sizes shall be increased as necessary to accommodate derated and type XHHW-2 conductors. Reduce conductor sizes at equipment terminations as required to accommodate maximum allowable conductor size accepted at equipment terminals per manufacturer's recommendations. Provide UL listed in-line reducer splice kit or UL listed cable reducing adapter plugs as required to reduce conductor sizes.
- D. Metering/Distribution Switchboard: Switchboard shall be built in accordance with ANSI and NEMA requirements and for seismic zone 3. Switchboards shall consist of incoming section, meter section, and distribution sections.
1. Enclosure: NEMA Class as indicated, gray enamel-finished heavy gauge steel, 90" maximum height, 30" depth. Sections shall be bolted together to form switchboard.
  2. Incoming Section: Consist of cable terminals (size and quantities as required for cable sizes and quantities indicated on Drawings), main circuit breaker, and busses.
  3. Metering and Ground Fault Protection Section: Consist of copper busses, mountings for current transformers, multi-function meter and ground fault protection equipment. All mountings, sockets, devices, barriers, and construction shall conform to USERC and utility company requirements.

4. Switchboards:

- a. General: Furnish and install, as shown on the plans, a service and distribution switchboard as specified herein.

- b. Configuration: The switchboard enclosure shall be:

NEMA 3R construction

Non walk-in, front accessible

Switchboard shall be of the modular type construction with the required number of vertical sections bolted together to form one metal enclosed rigid switchboard. The sides, top and rear shall be covered with removable screw-on code gauge steel plates. Switchboard shall include all protective devices and equipment as listed on the Drawings with necessary interconnections, instrumentation and control wiring.

Switchboard shall be constructed in accordance with the latest NEMA PB-2 and UL 891 standards.

- c. Bus Requirements: The bus shall be silver plated copper of sufficient size to limit the temperature rise to 65 degrees C, based on UL tests. The bus shall be braced and supported to withstand electro-mechanical forces exerted during short circuit conditions when directly connected to a power source having the indicated available short circuit current. Provide a full capacity neutral.
- d. Grade 5 bolts shall be used at bus joints. Ground bus and lugs shall be furnished. Ground bus shall extend the entire length of the switchboard and shall be firmly secured to each vertical section.
- e. Space heaters and a thermostat shall be provided in each switchboard section. Space heaters shall be sized to prevent condensation.
- f. Service Section: The service section shall be designed for the system parameters and shall have a digital multi-function meter and main protective device.
- g. Distribution Sections: Switchboard Type Group-Mounted, Front Accessible. Individual sections shall be front accessible, 30" deep maximum, and fronts of all sections shall align. Incoming line termination, main device connection and all bolts used to join current-carrying parts shall be installed so as to permit servicing from the front only so that no rear access is required. The branch devices shall be

front removable and panel mounted with line and load side connections front accessible.

- h. Main Protective Device: The main protective device, to be installed in the main device section, shall be: Molded case circuit breaker shall be of the quick-make, quick-break, trip-free, adjustable solid state type. It shall be 3-pole, 600-volt fully rated breaker with a trip current rating as indicated on the Drawings. The ampere interrupting capacity shall not be less than indicated for the switchboard.
- i. Branch Protective Devices: Molded case circuit breakers shall be of quick-make, quick-break, with frame, trip, voltage ratings, fully rated, and number of poles as indicated on the Drawings. All breakers shall have an interrupting capacity of not less than the interrupting capacity of the switchboard. All breakers shall be removable from the front of the switchboard without disturbing adjacent units. The switchboard shall have spares and space or provisions for future units as shown on the Drawings. Series rating not allowed.
- j. Metering Equipment: Provide a digital multi-function, high accuracy metering instrumentation module equipped with an LCD display, 2 digital inputs and 2 digital outputs, non-volatile memory of all set points and recorded maximums and minimums, and power supply. The power metering module shall provide peak demand and instantaneous measurements for kWh demand, kVA demand, KVAR demand, apparent and displacement power factor, frequency, total harmonic distortion %, phase currents, and voltages (L-L and L-N). ANSI C12.20 revenue metering accuracy suitable for sub-metering and sub-billing, KYZ pulse digital, Modbus RTU and ASCII, RS485 outputs. Provide with software and provisions as necessary for remote monitoring using the building LAN system and the building management system.
- k. Surge Protective Device (SPD): Provide an SPD in each switchboard. EACH SPD shall be bus connected for parallel operation, voltage matching rating of switchboard and rated for 3-phase, 4-wire systems, and have a minimum surge rating of 200kA per phase. The SPD shall be UL 1449 and UL 1283 Listed (latest editions). Each SPD shall have an audible alarm with silence switch, an alarm indicator light, and indicator lights for line-to-neutral, line-to-ground, and neutral-to-ground monitoring.
- l. Arc Energy Reduction: Provide arc energy reduction for circuit breakers rated 1,200A or more in compliance with NEC (2017) 240.87.

- m. Miscellaneous: The complete switchboard shall be phosphatized and finished with light grey, ASA-61 paint.

Each switchboard section shall have a nameplate permanently affixed to it, listing the following information.

Name of manufacturer  
System voltage, Number of phases, Number of wires  
Ampacity, Fault Current, Stored Energy  
Type  
Manufacturer's shop order number and date

Each section of switchboard shall bear a UL listing mark, where qualified, and a short circuit rating label.

In addition, the front, side, rear and top of each switchboard section will have a "DANGER – HIGH VOLTAGE" label in accordance with NEMA Standard PB-2.

- n. Manufacturer: Eaton, Siemens, Square-D, General Electric, or pre-approved equal.
  - o. Startup: Startup shall be performed by authorized factory trained representative or technician.
- E. Outlet and Small Junction Boxes: Pressed, zinc-coated steel, minimum nominal size 4", minimum depth 1-1/2", with raised cover- ring for devices in concrete masonry units. Exposed boxes and weather exposed boxes shall be ferrous alloy, prime painted and enamel finished, with threaded hubs for conduit connection. Surface mounted boxes shall be smooth walled with clean 90 degree corners.
- F. Large Junction Boxes: For dry interior locations, the box shall be fabricated from NEC gauge galvanized steel with matching screw-on type cover, field punched knockouts. Flush mounted junction boxes shall have flange type covers. For exterior, damp, wet, or corrosive locations, boxes shall be NEMA 4X stainless steel (316), pad lockable. All screws and hardware shall be stainless steel (316).
- G. Enclosures and Cabinets: Enclosures and cabinets for panelboards, enclosed circuit breakers, and safety disconnect switches shall be NEMA type, fabricated from galvanized steel, or as indicated, prime painted and enamel finished according to NEMA specifications. For dry interior locations, enclosures shall be NEMA 1. For exterior, damp, wet, or corrosive locations, enclosures shall be NEMA 4X stainless steel (316) with stainless steel (316) fasteners and hardware, pad lockable. Provide enclosures made of continuous welds. Enclosures made of bolted panels/parts will not be allowed.

H. Device and Cover Plates:

1. Plates for interior flush construction shall be smooth reinforced plastic, with suitable hole(s) and color to match device. Plates for receptacles on Department of Education projects shall be brushed stainless steel.
2. Device covers outlets in damp, wet, or corrosive locations shall be weatherproof with lockable stainless steel (316) covers. Covers shall permit plugs to be connected without compromising the integrity of the protective nature of the cover while in use.
3. Light switch plates for areas exposed to the elements, damp, or wet installations shall be neoprene gasketed cast aluminum, gray powder coat finish, with spring loaded neoprene gasketed flip-open lids.
4. Light switch plates for programmable light switches shall be labeled to describe the function of each switch/button.
5. Plates for receptacles on emergency circuits shall be red.
6. Plates for receptacles serving telecommunication loads on Department of Education projects shall be blue.
7. Plates for receptacles shall be labeled with the name of the panelboard and circuit number serving the receptacle.

I. Convenience Single and Duplex Receptacles:

1. Single and Duplex, 20 ampere, 125-volt, back and side wired, 3 wires, grounding type in ivory plastic body (provide red body for receptacles on emergency circuits), specification grade, tamper-resistant, with parallel and ground U-shaped slots. Enclose in outlet box and device plate. Hubbell SNAP5262, Leviton No. 5362 or pre-approved equal.
2. Ground Fault Circuit Interrupting (GFCI) receptacles shall be similar to the above except shall have test and reset switches and maximum allowable leakage current shall be 5 milli-amperes. Receptacles in restrooms, bathrooms, crawl spaces, and damp and wet locations shall be of the GFCI type.
3. Receptacles on emergency circuits shall be red.
4. Receptacles installed in exterior, damp, or wet locations shall be UL Listed weather resistant per NEC 406.9(A).
5. All receptacles shall be UL Listed tamper-resistant



- J. Special Receptacles: Contractor shall coordinate receptacle requirement type with contractor furnishing equipment and provide matching plug and cap. Outlet box size shall be commensurate with receptacle dimensions. Special receptacles shall conform to NEMA requirements. Provide specification grade with matching cap and cord, 6' length minimum, coordinate length with equipment being supplied. Provide red bodies (or coverplates when red bodies are not available) for receptacles on emergency circuits.
- K. Panelboard: Flush-mounted or surface-mounted as noted, ratings as indicated, 3-phase, 4WSN, ground bus, copper bussing, circuit breaker complement as shown, complete with lockable door, trim, type written directory, and 2-ply nameplate. Short circuit amperes interrupting capacity withstand ratings as indicated. Series rated panelboards not allowed. Full pole circuit breakers (half pole circuit breakers not allowed). Flush mounted panelboards shall be provided with flange type covers. Lockable with all new locks keyed alike. Eaton, Square D, General Electric, Siemens or pre-approved equal.
1. Isolated Ground Busses: In addition to the equipment ground bus, provide isolated ground busses in panelboards as indicated on the Drawings. Isolated ground busses shall be insulated from the panelboard enclosure and the equipment ground bus. The isolated ground bus shall be labeled "Isolated Ground".
  2. Surge Protective Device (SPD): Provide an SPD in panelboards where indicated on the drawings. Each SPD shall be bus connected for parallel operation, rated for 208Y/120V, 3-phase, 4-wire systems, and have a minimum surge rating of 120kA per phase. The SPD shall be UL 1449 and UL 1283 Listed (latest editions). Each SPD shall have an audible alarm with silence switch, an alarm indicator light, and indicator lights for line-to-neutral, line-to-ground, and neutral-to-ground monitoring.
  3. Minimum panelboard enclosure size shall be 20"W by 5-3/4"D unless mounted within switchboards or within power distribution centers.
  4. Dimensions of the panelboard shall be as required to accommodate the required circuit breaker compliments, wiring, and bus ampacity.
  5. Two section panelboards shall have the same enclosure dimensions.
- L. Kilo-Watt Hour Meter Socket: Number of jaws and current rated or current transformer (CT) rated as indicated on Drawings, USERC, test-isolation bypass facilities for current rated sockets, per HECO standards/requirements, NEMA 3R stainless steel 316 enclosure. Eaton Cutler-Hammer, Square-D, General Electric, or pre-approved equal.

- M. Duct Sealant: Shall not affect physical or electrical properties of wire and cable. Shall meet NEC codes for raceway seals and be UL listed. Shall be capable of holding 15 feet waterhead pressure continuous and block up to 4 psi gas or vapor continuous. Polywater FST, or pre-approved equal.
- N. Enclosed (Individual) Circuit Breakers: Shall consist of molded plastic case circuit breaker with toggle operated mechanism and thermal- magnetic overload trips. Interchangeable trip shall be provided when available. Toggle positions "On" and "Off", engraved or embossed on body. Provide lockable NEMA 1 enclosure for interior locations and NEMA 4X stainless steel (316) enclosure for exterior, damp, wet or corrosive locations.
- O. Manual Motor Starter Switches: Minimum number of poles and ampacity as required to match overcurrent protection device, single throw, UL label AC type, silver alloy contacts, black nylon handle, thermal overloads, horsepower rated, 120/208 volt. Continuous current rating of 16A minimum. Enclosed in NEMA 1 enclosure for interior locations and NEMA 4X stainless steel (316) enclosure for exterior, damp, wet, or corrosive locations. Manufacture and install according to NEC Articles 240 and 430. Eaton, Square-D, Cutler Hammer, General Electric, Bryant or pre-approved equal.
- P. Dry Type Transformers: Energy efficient type voltage, kVA and %Z ratings as indicated on Drawings, full capacity copper windings, constant potential, 3-phase and 4-wire unless otherwise indicated in Drawings, class 220 degrees C insulation, 80 degree C temperature rise, average sound level not to exceed 55dB, NEMA ST-20, copper windings, (6) 2.5% full capacity taps, (2) full capacity above normal and (4) full capacity below normal. KVA rating noted on drawings.
- 1) Transformer shall be designed to provide a minimum of 30% lower losses than NEMA TP-1 efficiencies under linear load.
  - 2) Efficiencies, no-load losses, load losses and impedance values shall be calculated at temperature reference of 75°C at UPF. No load losses shall be no more than the following:

<b>KVA</b>	<b>No Load Losses (Watts)</b>
<b>15 KVA</b>	<b>70 W</b>
<b>30 KVA</b>	<b>90 W</b>
<b>45 KVA</b>	<b>130 W</b>
<b>75 KVA</b>	<b>160 W</b>
<b>112.5 KVA</b>	<b>240 W</b>
<b>150 KVA</b>	<b>280 W</b>
<b>225 KVA</b>	<b>370 W</b>
<b>300 KVA</b>	<b>550 W</b>
<b>500 KVA</b>	<b>960 W</b>

KVA	Efficiency at 35% load
15 KVA	97.9%
30 KVA	98.3%
45 KVA	98.4%
75 KVA	98.6%
112.5 KVA	98.7%
150 KVA	98.8%
225 KVA	99.0%
300 KVA	99.0%
500 KVA	99.1%

- Q. Lighting Contactor: Electrically held, poles as indicated, coil voltage matching control circuit (as indicated), 600VAC contacts, 30 ampere. Enclosed in NEMA 1 enclosure for interior locations and NEMA 4X stainless steel (316) enclosure for exterior, damp, wet, or corrosive locations. Eaton, Square-D, General Electric, Siemens or pre-approved equal.
- R. Time Switch: Self-starting synchronous drive motor, astronomic dial calibrated for 21 degrees north latitude, adjusted to turn "ON" at 6:30 p.m. and "OFF" at 6:30 a.m., automatically changing settings each day in accordance with seasonal changes of sunset and sun rise. Electrically wound 10 hour spring carry-over, 120V timing motor and contacts, 60 Hertz, with two 1P40A contacts, manual bypass. Enclosed in NEMA 1 enclosure for interior locations and NEMA 4X stainless steel (316) enclosure for exterior, damp, wet, or corrosive locations. Tork 7200Z or pre-approved equal.
- S. Equipment Disconnect Switches: Heavy duty non-fusible safety switch as indicated, minimum ampacity, poles, and voltage shall match over-current protection device being served from. Horsepower rated when used as motor disconnect. Contacts shall be lever operated, and spring loaded. Enclosed in NEMA 1 enclosure for interior locations and NEMA 4X stainless steel (316) enclosure for exterior, damp, wet, or corrosive locations. Provide provisions for pad locking enclosure door if doors are not bolted closed as with NEMA 4X enclosures. Provide pad lock to secure enclosure door and key all pad locks alike. Manufacture and install according to NEC Article 240 and 430. Siemens, General Electric, Eaton, and Square-D or pre-approved equal.
- T. Nameplates: Laminated nameplates shall be provided for each switchboard (section, compartment, and device), panelboard, enclosed circuit breaker, safety disconnect switch, junction box, and cabinet for identification purposes.

1. Within electrical, inverter, telecommunication, and signal rooms: Laminated plastic shall be 1/8-inch thick Melamine plastic, black with white center core. Letters, numbers, symbols, or pictographs shall be incised a minimum of 1/32-inch into the plastic to expose the white core. Size of nameplate shall be 1-inch by 2-1/2 inches minimum. Lettering shall be minimum 1/4-inch high normal block lettering. Equipment designations shall be as indicated on the Drawings.
  2. Electrical High Voltage Warning Signs: Laminated plastic shall be 1/8-inch thick Melamine plastic, red with white center core. Letters, numbers, symbols, or pictographs shall be incised a minimum of 1/32-inch into the plastic to expose the white core. Warning signs shall be sized to accommodate required wording. Lettering shall be minimum 1/2-inch high normal block lettering. Warning signs shall read as indicated and if not indicated shall read "DANGER HIGH VOLTAGE". Warning signs shall be provided on all electrical room doors, panelboards not located within electrical rooms, free-standing exterior mounted switchboards, and other electrical apparatus not located within spaces with authorized access only.
- U. Labels: Thermal transfer or direct thermal labeling; minimum 1/8" high black lettering on white background; self-adhesive backing; sunlight, water and moisture resistant. Kroy or approved equivalent.
- V. Hardware, Supports, Backing, Etc.: All hardware, fasteners, supports, backing and other accessories necessary to install electrical equipment shall be provided. Wood materials shall be "wolmanized" treated against termites, iron or steel materials shall be galvanized for corrosion protection, and non-ferrous materials shall be brass or bronze. Installations in damp, wet, or corrosive locations shall be of stainless steel, 316.
- W. MOTOR CONTROL CENTERS
1. Motor control centers shall be as manufactured by Siemens, or approved substitute.
    - a. The assembly shall have a NEMA Type 1 with a NEMA Type 3R stainless steel (316L) enclosure with NEMA Class II Type C wiring. Complete one-line, elementary control diagrams, device connection diagram and suitable outline and installation drawings shall be furnished by the manufacturer for approval.
    - b. The assembly shall be of the front accessible type with wiring space located at the top and bottom of the structures. Each section shall have vertical wireways with separate doors. The dimensions indicated are approximate. Dimension may vary to house all equipment specified herein.

- c. The assembly shall be totally enclosed, free standing type with sections bolted together to form one assembly. If practical, the entire assembly shall be shipped as one unit. Otherwise, provisions shall be made by the manufacturer to bolt the bus-bars and individual sections together after the units are arranged inside the buildings and structures to conform to the arrangement indicated on the plans.
- d. The structure units shall consist of fabricated steel, shaped and reinforced to form rigid, free-standing standardized units and shall be in accordance with UL 845. Each structure shall be so designed that units may be readily removed or future structures added as required.
- e. The assembly shall consist of the number of vertical sections and the structures shall be arranged as indicated on the drawings. Assembly shall be bolted to raised concrete pad.
- f. All front doors shall be hinged and shall be held closed by means of door locking screws. The doors shall be a part of the structure and not a part of the starter so they may be closed to cover open buses after starter has been removed. All doors of the Motor Control Center shall be constructed with concealed hinges. The doors shall not be hindered from opening/closing by adjacent equipment and walls. The structure shall have back plates for each vertical section.
- g. Each structure unit shall be provided with two horizontal wiring spaces, one at the top and the other at the bottom, which will line up with adjacent units to form convenient wiring raceways the entire length of the control center. In addition, each structure shall have a vertical wiring space between the starter cell and side sheet for unit wiring. The vertical wiring space shall be equipped with cable tie supports to hold cable and wiring in place.
- h. A main horizontal copper bus rated as indicated shall be provided across the top of each structure. Bus bars shall be rectangular cross section and supported in each structure by means of insulated bus supports. The bus bars shall be braced for fault current indicated and shall be tin plated copper.
- i. The structure units shall be thoroughly cleaned inside and out before fabrication and then be given a primer coat prior to two finish coats of medium light gray.
- j. Channel iron sills and lifting angles shall be provided by the manufacturer to facilitate installation of the control center.

- k. After installation, all enclosures shall prevent entry of a 0.375-inch diameter sphere through any exterior opening. Air vents and openings at the floor level shall be covered with metal screens as necessary to meet this requirement.
- 2. Profibus System.
    - a. Profibus cabling shall be routed through the motor control center, isolated from unit spaces.
    - b. The addition or removal of a unit from the Ethernet/IP system shall not interrupt the operation of other units within the system.
    - c. Motor starters shall have control and monitoring capabilities via Profibus PA, Ethernet/IP communications, or approved substitute.
  - 3. Voltage: The motor control center is to be rated for 480 volts, 3 phase, 4 wire, unless otherwise noted.
  - 4. Nameplates: Nameplates shall be laminated plastic as specified in Section 16000, "General Electrical Provisions".
  - 5. Circuit Breakers: The circuit breakers shall be molded case type manually operated, trip free from the handle and provided with inverse-time, thermal-element overload protection. The circuit breakers shall have an interrupting rating of not less than indicated. The operating handle shall clearly indicate whether the breaker is "on," "off," or "tripped." Means shall be provided to lock the breaker in "off" position. Each circuit breaker shall have an auxiliary switch and an alarm switch. The auxiliary switch shall indicate the status of the circuit breaker contacts (opened or closed). The alarm switch shall indicate that the circuit breaker has tripped. The alarm switch shall automatically reset when the circuit breaker has been reset.
  - 6. Circuit Breaker and Starter Units: All auxiliary motor starter or circuit breaker units shall be built in interchangeable units and shall be line plug-in type. Guide rails shall be provided in the structure for supporting and aligning the unit starter during its removal or replacement. Plug-in units shall have pressure type line disconnecting stabs of high strength copper alloy.

Each unit shall be held in place by means of quick captive screw fasteners arranged so the units can be removed or remounted readily without access to the rear of the structure. Each unit shall be totally enclosed and effectively baffled to isolate any ionized gases which may occur within the unit starter. Each unit shall be so ventilated that it can be located anywhere within the structure using the same overload heaters for the same load.

The circuit breaker for combination starters shall be motor circuit protector type provided with magnetic trip unit that is adjustable and UL listed for use with starter. The breakers shall have continuous ratings to match the motor nameplate horsepower shown on the single line diagrams. The circuit breakers shall have a minimum of six trip adjustment points. Circuit breakers shall also have provisions for manual tripping. This trip device shall provide mechanical simulation of overcurrent tripping through activation of linkages and latch surfaces that are not operated by the circuit breaker handle. The external toggle switch operating handle of the circuit breaker shall have provisions for installing a padlock in the open position. Each circuit breaker shall have an auxiliary switch and an alarm switch. The auxiliary switch shall indicate the status of the circuit breaker contacts (opened or closed). The alarm switch shall indicate that the circuit breaker has tripped. The alarm switch shall automatically reset when the circuit breaker has been reset.

7. Motor starters installed in motor control centers shall be located as shown on the drawings in motor control centers furnished by the motor control center manufacturer. These motor starters shall contain cadmium plated "stab-on" self-aligning connectors having free floating spring construction to ensure a positive cadmium-to-tin contact at both sides of the bus. The starter units and the associated "stab-on" connectors shall include provisions for guiding the units from their disconnected or withdrawn position to their connected position. The starters shall be interchangeable with starters of the same size. Motor starters shall have replaceable, heavy-duty contacts of the welding type with wipe action to keep contacts clean. Motor starter wiring and components shall be readily accessible. Under and over voltage release, running time meter, surge and phase failure protection, auxiliary control transformer, and all necessary pilot devices shall be provided. Identification nameplate shall provide motor designation, horsepower rating, and voltage characteristics.

Type: Motor starters for nonreversing, single speed motors rated less than 25 HP shall be full voltage, nonreversing starters. Motor starters for single speed nonreversing motors rated at 25 HP and above shall be reduced voltage, solid-state starters, unless otherwise indicated. All multiphase motors shall be furnished with magnetic contactor starters. Single phase motor starters shall either be magnetic or manual, as indicated on the drawings.

8. Overload Elements: Overload elements shall be bimetallic or eutectic ambient temperature compensated overload relays. Magnetic contactors for all 3-phase motor starters shall be equipped with overload relays on each phase and complete with reset button. Additional auxiliary overload contacts shall be provided for "motor fail" alarm circuiting on all motors.

Single phase motor starters shall contain only one overload trip element for 120 volt applications and two overload trip elements for 240 volt applications.

9. The pilot lights shall be LED, oil-tight transformer push-to-test type with color cap lenses as indicated. The nameplates for the pilot lights shall be attached to the collar of the pilot light or with laminated nameplate.
10. The hand-off-auto selector switches shall be heavy duty, oil-tight lever operated type. Collar type of laminated nameplate shall be provided.
11. Pushbutton shall be heavy duty oil-tight type with black button flush with the guard.
12. All auxiliary relays shall be machine tool type with contact rating of 10 amperes minimum and the coils shall be rated for continuous operation. Timers shall be pneumatic diaphragm type.
13. Each starter shall be provided with control transformers rated 480-120 volts and shall be provided with fuses. Transformer capacity shall be adequate for the intended use, minimum of 150% of burden.
14. Process time switches shall be as indicated and shall be housed in the motor control center.
15. Tin-plated copper ground bus shall be provided.
16. Voltmeter, ammeter and related selector switches shall be flush mounted.
17. Communication Interface:
  - a. Internal equipment network protocol shall be Profibus, Ethernet/IP, or approved substitute.
  - b. Equipment shall be connected to the Plant Control System network and operate on the network protocol as shown on the control system block diagram. The Contractor shall provide network interface hardware suitable for direct interface to the Plant's Control System as shown on the Drawings and specified under Division 13.
  - c. Coordinate network addresses with Owner and fully configure and setup all port addressing and equipment variable memory maps and register addressing at the factory.
  - d. Provide all internal equipment networking components, wiring, and terminations installed, configured, and fully tested at the factory.
  - e. Network component installation and configuration shall maintain the UL listing of the equipment. Provide all additional testing, inspections, and equipment modifications necessary to maintain the equipment UL listing.



- f. Equipment network communication interface shall be installed in a suitable, dedicated low voltage control compartment. Operators and maintenance staff shall not be exposed to voltages over 150 Volts to ground when accessing the communication interface.
- g. Provide all required power supplies for the communication interface integral to the equipment.
- h. Selection of available equipment parameters shall be coordinated with the Owner. Required operating parameters to be monitored shall be as shown on the Drawings. However, at a minimum, provide each monitored piece of equipment with 20 discrete and 5 analog monitored variables (mix of inputs and outputs). Contractor shall make provision to program, configure, map, and deliver this data coordinated with the plant control system specified in Division 13.
- i. Data transport from equipment nodes shall be implemented in block or array formats with discrete variables packed contiguously into words. Packed discrete words and analog variables shall be stored in contiguous memory arrays for efficient transport. Coordinate final block transport details with the PCSI and City including PLC addressing, variable types, and variables storage locations.
- j. Contractor shall allocate network resources, hardware components, wiring strategies, and segments within the equipment to ensure delivery of the specified variables to the controller or other device within a maximum period of 1 second following a read request.

X. Distributed I/O Modules:

- 1. General: Provide additional I/O modules where there is insufficient resident or expansion I/O capacity on the standard MCC starter components to meet the control and I/O requirements as shown on the Drawings. Provide module power supplies, Ethernet adapters, and I/O modules as required. Module wiring shall match the MCC NEMA Class and Type as specified.
- 2. Provide Digital Output modules with a minimum of four relay outputs per module. Contact outputs shall be rated a minimum of 6 amps at 120VAC. Provide interposing relays for each I/O output point. Interposing relays shall be mounted in the same MCC bucket as the I/O module.
- 3. Provide Digital Input modules with a minimum of four 120VAC inputs.

4. Provide a minimum of two spare I/O points for each type provided for a specific MCC bucket. Spare I/O shall be fully wired including interposing relays, terminal blocks, wire tagging, etc.
5. Provide inscribed Phenolic nameplates, red lettering on yellow background inscribed "CAUTION, FOREIGN VOLTAGE PRESENT" where expansion I/O modules are powered from external motor starters or other components.
6. Provide suitable interconnection Profibus cable rated 600V minimum when routed within the MCC structure and wireways.
7. Provide individual distributed I/O power supply for each MCC starter bucket. Power supply shall be sized to serve all starter bucket I/O modules plus 50% spare capacity. Power supply shall be fed from starter resident control power transformer as specified herein, sized to accommodate the Distributed I/O power supply requirements.

Provide I/O modules as Manufactured by Siemens, Eaton, SquareD, general Electric, Mitsubishi or approved substitute.

Y. AUTOMATIC TELEPHONE DIALER SYSTEM:

1. Description and Phone Number Dialing: The dialer shall be a solid state component capable of dialing up to 16 telephone numbers, each up to 60 digits in length. Phone numbers and Standard pulse dialing or Touch Tone DTMF dialing are user programmable via the system's keyboard or remotely via Touch Tone telephone. In addition, the dialer shall:
  - a. Group Alarm Calls - On alarm, system shall selectively call the correct phone number according to the specific alarms(s).
  - b. Detect Telephone Line Fault and indicate condition with Front Panel LED.
  - c. Automatically select Tone versus Pulse Dialing.
  - d. Monitor Call Progress - Detect Busy and Ringing Signals, Abandon Call if Busy, Wait until phone is answered to Annunciate Voice Reports.
  - e. Provide Numeric Pager Support.
  - f. Provide PBX Support.
2. Solid State Voice Message Recording & Playback: The unit shall have two different categories of speech message capability, all implemented with permanent non-volatile solid state circuitry with no mechanical mechanisms. The unit shall allow for message recording from a remote telephone as well as from the front panel.

- a. User Field Recorded Messages: The user may record and re-record his own voice messages for each input channel for the Station ID.
    - i. There shall be no limit on the length of any particular message within the overall available message recording time, which shall vary from 26 to 635 seconds, depending upon the number of input channels selected, and the recording rate used.
    - ii. The unit shall allow selective recording of both Normal and Alarm advisory messages for each input channel.
    - iii. The unit shall provide for automatic setting of the optimum speech recording rate for the total set of messages recorder, in order to achieve optimum recording sound quality.
    - iv. Circuit board switches or jumper straps shall not be an acceptable means of manipulating message length or recording rates.
  - b. Permanent Resident Non-Recorded Messages: Permanent built-in messages shall be included to support user programming operations, to provide supplemental warning messages such as advising that the alarms have been disabled, and to allow the unit to be fully functional even when the installer has not recorded any messages of his own.
3. Input Monitoring Function: The basic unit shall continuously monitor the presence of AC power and the status of eight (16) contact closure inputs. AC power failure, or violation of the alarm criteria at any input shall cause the unit to go into alarm status and begin dial-outs. The unit shall, upon a single program entry, automatically accept all input states as the normal non-alarm state, eliminating possible confusion about Normal Open versus Normally Closed inputs. Further, as a diagnostic aid, unit shall have the capability of directly announcing the state of any given input as currently "Closed Circuit" or "Open Circuit" without disturbing any message programming. Each input channel shall also be independently programmable, without the need to manipulate circuit board switches or jumpers, to any of the following:
  - a. Normally Open, Normally Closed, or for No Alarm (Status Only).
  - b. Run Time Meter - to accumulate and report the number of hours a particular input circuit has been closed. Any channel so configured will never cause an alarm call, rather, on inquiry will recite its message according to the status of the input and then report the closed circuit time to the tenth of an hour. The input will accumulate and report in tenths of hours up to a total accumulated running time of 99,999.9 hours. The initial value of the Run Time Meter shall be programmable in order to agree with existing electro-mechanical Run Time Meters. Up to a total of

8 Run Time Meters may be programmed.

- c. Pulse Totalizer - to count the accumulated number of pulses (momentary contact closures) occurring at the input so programmed. Any input channel may be programmed for a Totalizer Function, up to a maximum of 8. Maximum Input pulse rate is 100 HZ, with a 50% Duty Cycle. The spoken scaled value will not "roll-over" to zero until a value of 4,294,967,294 has been exceeded.
- 4. Input/Output Expansion Capability: The standard unit shall be modular in design, permitting it, therefore, to accept "plug-in" expansion circuit boards to incorporate any of the following:
    - a. Contact Closure Expansion Capability to a total of 16, 24, or 32 total dry contact inputs.
    - b. Analog Input Capability to a total of 1, 4, 8, or 16 total analog inputs.
    - c. Remote Supervisory Control Outputs to manipulate 4 or 8 output relays.
  - 5. Modbus Communications: The unit shall accept an expansion card which enables it to communicate directly with devices utilizing Modbus RTU Protocol. A unit so configured shall be capable of "reading" and "writing" to 32, 64, or 96 data registers via Touch Tone Telephone. No modem or host computer shall be required. Interface shall consist of a single RS-232 Serial Cable.
  - 6. Printer/Computer Communications: The unit shall be equipped with a centronics parallel printer port, enabling the user to print alarm reports, download programming data, and generate scheduled status reports as required. Alternatively, the unit shall be able to accept an optional modular, plug-in asynchronous communications card to permit any of the following:
    - a. Local Data Logging - Permits a single dialer to communicate with a local Serial printer to log routine status reports, alarm reports, and programming data.
    - b. Central Data Logging - Permits one or more dialers to communicate with a single centrally located Serial printer equipped with a suitable modem to log routine status reports, alarm reports, and programming data.
    - c. Data Acquisition and Control - Permits one or more dialers to communicate with a centrally located Computer/Printer System equipped with a SCADA software package, thereby functioning as a stand alone SCADA system.
  - 7. Alarm and Inquiry Messages: Upon initiating an alarm call, the system is to

"speak" only those channels which are currently in "alarm status". Inquiry phone calls can be made directly to the unit at any time, for a complete status report.

8. Acknowledgment: Alarms are acknowledged either by pressing a Touch Tone "9" as the call is being received, or by calling the unit back after having received an alarm call.
9. Nonvolatile Program Memory Retention: User-entered programming and voice messages shall be kept intact, even during power failures or when all power has been removed, for up to ten (10) years. This shall be accomplished through inclusion in the system of a lithium battery separate from the unit's backup rechargeable cell battery.
10. Local and Remote Programming Capabilities: The user may optionally elect to alter the following parameters from their standard normal default values via keyboard entry or remotely from any Touch Tone telephone.
  - a. Alarm Response Delay: 0.1 to 999.9 seconds, with different delays being assignable to different alarms.
  - b. Delay Between Alarm Call Outs: 0.1 to 99.9 minutes.
  - c. Alarm Reset Time: 0.1 to 99 hours, or "No Reset".
  - d. Incoming Ring Response (Answer) Delay: 1 to Rings.
  - e. Number of Message Repetitions: 1 to 20 Repetitions.
  - f. Auto call Test: When enabled, the unit shall place a single round of test calls both at the time this function is enabled, and also at regular subsequent intervals until this function is disabled.
  - g. Remote System Microphone Activation.
  - h. Remote Arming and Disarming of System.
11. Phone Line: The dialer is to use a standard "dial-up" telephone line (direct leased line is not required), and is to be F.C.C. approved. Connection to the telephone is through a 4-pin modular jack (RJ 11).
12. Speakerphone: The unit shall be capable of dialing any phone number on command and functioning as a speakerphone.
13. Real Time Clock: The unit shall be equipped with a real time clock thereby making it possible to:

- a. Alarm Ready Schedule - The dialer shall be user programmable to follow a specific schedule of operations. This shall include the flexibility to set a weekday, weekend and holiday schedule. With this feature the dialer shall arm and disarm itself according to the schedule programmed.
  - b. In the event any of the printer configurations outlined in Section 6 are utilized, all alarm reports will be time and date stamped. Routine scheduled status reports can also be programmed.
14. Power/Battery Backup: Normal power shall be 105-135 VAC, 15 watts nominal. The product is to contain its own gel cell rechargeable battery which is automatically kept charged when AC power is present. The system shall operate on battery power for a minimum of 20 continuous hours in the event of AC power failure. A shorter backup time shall not be acceptable. The built-in charger shall be precision voltage controlled, not a "trickle charger", in order to minimize recharge time and to maximize battery life available.
15. Integral Surge Protection: All power, phone line, dry contact, and analog signal inputs shall be protected at the circuit board to IEEE Standard 587, category B (6,000 volts open circuit/3000 amps closed circuit). Gas tubes followed by solid state protectors shall be integral to the circuit board for each line.
16. Technical/Customer Support: All users shall be provided and/or shall have access to the following support resources.
- a. Each auto dialer shall be shipped with a CD-ROM which details all features of the product and provides an in-depth step-by-by programming guide. A superficial marketing overview will not be acceptable.
  - b. Free Live Chat support on RACO's website staffed with trained technicians shall be available during manufacturer's normal working day.
  - c. Free comprehensive web-based support center with over 550 FAQs shall be available for customers to retrieve copies of all available technical information directly into his own computer. The support center shall have an optimized user interface for smartphones at <http://www.racomobilesupport.com>, allowing users to quickly navigate to the desired support topics. This service shall be available on a 24 hour basis.
  - d. A toll free 800 number shall be available during manufacturer's normal working day to permit users to talk directly with technical service personnel and resolve problems not solved by the RACO web-based Support Center.

17. Warranty: The dialer shall be covered by a FIVE (5) YEAR warranty covering parts and labor performed at the Factory.
18. Additional Features: Sealed Switches, LED Indicators, Alarm Disable Warning, Talkthrough: All keyboard and front panel switches shall be sealed to prevent contamination. Front panel LED's shall indicate: Normal Operation, Program Mode, Call in Progress, Status for each Channel, AC Power present, AC Power failure, and Low, Discharging, or Recharging Battery. On any inquiry telephone call, or On-Site status check, the voice shall provide specific warning if no dial out phone numbers are entered, or if the unit is in "alarm disabled" mode, or if AC power is off or has been off since last reset. A built-in microphone shall allow anyone at a remote site to listen to Local sounds and to have a two-way conversation with personnel at the dialer.
19. Manufacturer and model shall be RACO Verbatim Modular Series VSS or approved equivalent.

### PART 3 - EXECUTION

#### 3.1 GENERAL

- A. Rules and Permit: The entire installation shall be made in strict accordance with the latest rules and regulations of the National Board of Fire Underwriters, the currently adopted edition of the National Electrical Code and the Electrical Branch of the local Building Department. The Contractor shall obtain and pay for the electrical permit as required by local laws and rules. All work shall be inspected by the proper local authorities as it progresses. The Contractor shall pay all inspection fees and shall deliver certificates of completion and inspection to the Project Engineer before final payment will be made. Costs of permits and inspection fees shall be included in the Contractor's bid price.
- B. Construction Methods: Construction shall conform to construction practices as recommended by the American Electricians Handbook by Croft (latest edition), Edison Electric Institute, National Electrical Code, National fire Protection Association, National Electrical Safety Code and applicable instructions of manufacturers of equipment and material supplied for this project.
- C. Materials and Workmanship: All labor and materials of every kind shall be subject to the approval of the Project Engineer, who shall be afforded every facility for ascertaining the competence of such labor and examining such materials as they may deem necessary. Concealed work, handholes, and enclosures shall be reopened / opened at random as directed during inspections by the Project Engineer. Materials shall be new and shall bear the listed label of the Underwriters' Laboratories, Inc. Brand names and catalog numbers used in this specification indicate the standards of design and quality required. Substitution of other brands or catalog numbers shall conform to the requirements in the Bidding Documents.

All high voltage work shall be performed by qualified electricians certified to work on high voltage systems.

- D. Record Drawings: The Contractor shall maintain an accurate and adequate record of each change as it occurs, regardless of how ordered.
- E. Drawings and Specification: This specification is intended to cover all labor, materials and standards of workmanship to be employed in the work indicated on the Drawings and called for in the specification or reasonably implied therein. The Drawings and specification supplement one another. Any part of the work mentioned in one and not represented in the other, shall be done the same as if it has been mentioned in both. The Contractor shall not make alterations in the Drawings and specification.
- F. Discrepancies and Interpretations:
  - 1. Should the Contractor find any discrepancies in or omissions from any of the documents or be in doubt as to their meaning, he shall advise the Project Engineer who will issue any necessary clarification within a time period which does not disrupt the progress of the work.
  - 2. All interpretation and supplemental instructions will be in the form of a written addenda to the Contract Documents.
  - 3. Should any discrepancy arise from the failure of the Contractor to notify the Project Engineer, the higher quality or larger quantity of item shall prevail. The Project Engineer shall make the final interpretation and judgment.
  - 4. In the event of a discrepancy between small scale drawings and large scale details, or between the Drawings and specification, on which is in violation of any regulations, ordinances, laws or codes, the discrepancy, if known by the Contractor, shall be immediately brought to the attention of the Project Engineer for a decision before proceeding with the particular work involved. Work carried out disregarding these instructions will be subject to removal and replacement at the Contractor's expense.
- G. Symbols: The standard electrical symbols together with the special symbols, notes and instructions shown on the drawings indicate the work and outlets required and are all to be included as a part of this specification.
- H. Coordination: This specification is accompanied by Drawings which contain floor plans of the buildings, sections and elevations, and site plans indicating locations of all outlets, switch controls, service runs, and other electrical apparatus. These locations are approximate and, before installing, the Contractor shall study the adjacent architectural details and actually make the installation in the most logical manner. Any outlet, equipment, feeder, and circuit may be relocated within ten feet



before installation at the direction of the Project Engineer. The circuit routing is typical only and may be varied in any logical manner.

### 3.2 INSTALLATION

#### A. Grounding:

1. All services, metallic enclosures, raceways, and electrical equipment shall be grounded according to requirements of NEC Article 250. At building, 3/4" x 10' copper ground rods, Copperweld Steel Company, shall be driven with top 12" below finished grade and shall be connected together with bare copper wire buried 12" below finished grade to obtain a ground of 25 ohms or less as measured by three point pot method with an electric ground megger. Connect ground to nearest cold water pipe (located within 10' of entering the building), structural steel, and to building entrance equipment with bare copper. Ground and bond per the NEC and local authority having jurisdiction. Final connection to equipment, raceways, grounding type receptacles and other metallic parts directly exposed to ungrounded electric conductors shall be No. 8 AWG minimum, copper, NEC type TW, green insulation. Use approved bonding terminal at panels.
2. All grounding wire runs within building shall be routed together with circuit conductors.
3. Bond and ground all feeder conduits to panelboard enclosures.
4. Provide isolated ground wire from each isolated ground bus, in each panelboard, to the secondary neutral ground of the transformer serving the panelboard.

#### B. Wiring System:

1. Below grade, within concrete floor slabs or within concrete walls use Schedule 40 PVC. Provide separate ground wire and rise out of ground or concrete slab with PVC and transition to medium walled epoxy resin coated fiberglass conduit within 6" of finished grade. For conduits rising out of walls, transition to galvanized rigid steel conduit as required below within 6" of emerging from the wall.
2. Above finished ground floor where exposed below 7'- 0" above finished floor use rigid steel conduit; in non-air conditioned locations use rigid steel conduit; exposed on the exterior of the building or beneath the building use rigid steel conduit; where exposed on exterior of the building and exposed to sunlight use regular walled sunlight-resistant epoxy resin coated fiberglass conduit with white finish and threaded fittings. Where exposed to corrosive atmospheres and near shorelines use regular walled sunlight-resistant epoxy

resin coated fiberglass conduit. Where exposed to damage use rigid steel conduits or medium walled sunlight-resistant epoxy resin coated fiberglass conduits.

3. Above finished ground floor where concealed in stud walls or above suspended ceilings, and not exposed to damage, use EMT with compression fittings.
4. Where exposed on the roof, in damp, wet, or corrosive locations use sunlight-resistant epoxy resin coated fiberglass.
5. All wiring shall be installed in conduits except as noted.
6. Conduit system shall be continuous from outlet to outlet and fitting to fitting so that electrical continuity is obtained between all conduits of the system.
7. Conduits cut square and inner edges reamed. Butt together evenly within couplings.
8. Make bends and offsets with hickey or conduit-bending machine. Do not use vise or pipe tee. Flattened or crushed conduit not acceptable.
9. Use of running threads not permitted. Where conduits cannot be joined by standard threaded couplings, approved water-tight conduit unions shall be used.
10. Cap conduits during construction with plastic or metal-capped bushings to prevent entrance of dirt and moisture. Swab all conduits and dry before installing wires. Provide removable watertight conduit seals on all conduits entering the building, or pad mounted equipment, where the conduit is connected to manholes, handholes, light poles, or other pad mounted equipment.
11. Pullstrings shall be placed in all empty / spare conduits ten feet in length or longer.
12. Install insulating bushings and two locknuts on each end of every conduit run at enclosures and boxes. Provide grounding bushings as required.
13. Conduits shall not be installed in slabs. Route circuits feeding floor boxes in the ceiling space of the floor below.
14. Conduits passing through floor slabs and fire rated walls and ceilings shall be fire proofed.

15. Provide control conduit and wiring between the building management system and digital multi-function meters and programmable panelboards. Provide control conduit and wiring between all programmable panelboards.
16. Conduit bodies shall not be used on telecom conduits.

C. Conductors:

1. Mechanical means for pulling shall be torque-limiting type and not used for #2 AWG and smaller wires.
2. Pulling tension shall not exceed wire manufacturer's recommendations.
3. Where necessary, powdered soapstone may be used as a lubricant for drawing wires through conduit. No other means of lubricating will be allowed.
4. Form neatly in enclosures for minimum of crossovers. Tag all feeders and label all branch circuits in all enclosures and devices. Identify panel name and branch circuit number.
5. Color code feeder, branch circuit, and grounding conductors. Color for grounding conductors shall be green. Color for neutral conductors shall be white except for where neutrals of more than one branch circuit grouping are installed in the same raceway or enclosure, the other neutral shall be white with a colored stripe (other than green). The color coding for three-phase and single-phase circuits shall be as follows:

208Y/120V, 3-phase, 4-wire:	Black (Phase-A)
	Red (Phase-B)
	Blue (Phase-C)
480Y/277V, 3-phase, 4-wire:	Brown (Phase-A)
	Orange (Phase-B)
	Yellow (Phase-C)

D. Splicing of Wire and Cable:

1. Wires shall be formed neatly in enclosures and boxes.
2. Splices made according to NEC Article 110.
3. Splices shall be reinsulated. Remove all sharp points that can pierce tape. Use Minnesota Mining and Manufacturing Co. "Scotch" #33 tape, or pre-approved equal. Splices in pull boxes shall be water-tight.
4. Below grade splices not allowed for fire alarm circuits.

E. Boxes and Enclosures:

1. Not all boxes are shown on the Drawings. The number of conduit bends between pull points shall not be greater than four quarter bends (360 degrees total) per NEC. For telecommunication conduits the number of conduit bends between pull points shall not be greater than two quarter bends (180 degrees total). Provide additional boxes as necessary.
2. Provide outlet boxes in hollow tiles or concealed in other spaces with extensions or raised rings of such depth that metal will be flush with surrounding surfaces or openings.
3. Offset boxes, on opposite side of walls, by 6" to minimize noise transmission thru walls.
4. Boxes installed in 2 and 3 hour fire rated walls shall be fire proofed to maintain the integrity of the fire rated walls.
5. Boxes to be plumb and exactly flush.

F. Convenience Outlets: Shall be installed vertically, centers eighteen inches above the finish floor unless otherwise indicated.

G. Finishing:

1. All cutting that may be required for complete installation of the electrical work shall be carefully performed, and all patching shall be finished in first-class condition by the Contractor.
2. Close unused knockouts in boxes or enclosures with metal cap that will maintain the rating of the box or enclosure.
3. Wipe clean all exposed raceways and enclosures with rag and solvent. Unfinished raceways and enclosures shall be primed and painted and finished to blend in with the surface it is mounted on. (Do not cover nameplates.) Factory finished enclosures shall not be painted, touch up where required.

H. Miscellaneous Details:

1. The drawings indicate connection of electrical loads. After installation, measure the load at each panelboard and re-connect the loads to balance the loads within +/- 10% of each phase. Provide revised typewritten panel directories as required.

2. After the final service and feeder connections have been made, check and correct, if necessary, the rotation of all motors. Coordinate the rotation with the contractor responsible for providing the driven equipment.
3. Cut, drill and patch as required to install electrical system. Repair any surface damaged or marred by notching, drilling or any other process necessary for installation of electrical work. Cutting, repairs and refinishing subject to the approval of the Project Engineer. Need for remedial work determined by the Project Engineer as attributable to poor coordination and workmanship shall be cause for reconstruction to the satisfaction of the Project Engineer and at no additional cost to the Project Engineer.
4. Attachment of electrical equipment to wood by non-ferrous wood screws. Attachment to concrete by expansion anchors. Powder-charge-driven studs and anchors permitted only with prior approval.
5. Complete all panel circuit directories, using typewriter. Verify "room" and "use" designations before typing.
6. Prime and paint all exposed conduits, hangers, and fasteners.
7. All grounding wire within building run in rigid steel conduit.
8. Furnish necessary test equipment and make all tests necessary to check for unspecified grounding, shorts and wrong connections. Correct faulty conditions, if any.
9. Tag all empty conduits in switchboard, panelboards, cabinets, at backboards, etc. and identify destination.
10. Provide arc flash warning labels on all electrical equipment as required by 2017 NEC Article 110.16 and 2015 NFPA-70E 130.5. The contractor shall obtain all information required for the calculations, perform the calculations, and provide the labels at no additional cost.
11. Anchor all free-standing floor mounted electrical equipment, apparatus, and transformers. Provide additional bracing per the seismic conditions at the site.
12. Provide plastic safety end caps on all c-channel ends. End caps shall be U.V. stabilized where installed exposed to the weather and sunlight.
13. Provide permanent labels on all switchboards, switchgear, motor control centers, and panelboards indicating where the power originates from.

### 3.3 TESTING AND INSPECTION

- A. If the Project Engineer (or its representative) discovers any errors, the Contractor, at his own expense, shall go over all similar portions of the entire job, taking the necessary or directed remedial action.
- B. Installations of feeders to electrical distribution equipment including but not limited to panelboards, switchboards, switchgear, and motor control centers 600 volts and less shall be tested for insulation resistance after all wiring is completed and ready for connection to fixtures and equipment. Using a 500V megger, measure and record the insulation resistance from phase to phase and phase to neutral. The records shall be submitted to the Project Engineer for review and approval.
- C. The Contractor shall re-tape splices which have been bared for inspection. The Contractor shall test all portions of the electrical system furnished by him for proper operation and freedom from accidental grounds. All tests shall be subject to the approval of the Project Engineer.
- D. Wherever test or inspection reveals faulty equipment or installation, the Contractor shall take corrective action, at his own expense, repairing or replacing equipment or installation as directed.
- E. The Contractor shall de-energize, test (to verify de-energization), open, remove, and replace switchboard and panelboard covers for pre-final and final inspections by the Project Engineer.

END OF SECTION

## DIVISION 16100 – SCADA SYSTEM

### SECTION 16100 – SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA) SYSTEM

#### PART 1 – GENERAL

##### 1.1 GENERAL CONDITIONS

This section covers the Supervisory Control and Data Acquisition (SCADA) system including equipment, wiring, adjustment and testing as indicated on the plans and specified herein.

- A. As specified in Section 16000 – Electrical Work. The provisions of these related sections apply to this section and work described in this section shall comply with them.

##### 1.2 SCOPE OF WORK

Provide all articles, materials, equipment, operations, and services herein or on Drawings, including all labor, materials, taxes, fees, insurance, and incidentals required to insure completion.

- A. Test Complete Installation

Installation shall be complete in every detail as specified and ready for use. Any item supplied by Contractor developing defects within one year of final acceptance by Owner shall be replaced by such materials, apparatus, or parts to make such defective portion of complete system conform to true intent and meaning of these Drawings and Specifications, at no cost to Owner.

- B. System Overview

These specifications are for a distributed supervisory control and data acquisition (SCADA) system for a water system, including Programmable Logic Controller (PLCs). Initially, this system shall require the furnishing of all PLC hardware and installation of a SCADA ready enclosure at the Upolu Well Site. This system shall require but not limited to the following work:

1. Providing one (1) PLC at the new Upolu Well site, including but not limited to the following major equipment:
  - a. Siemens Simatic S7-1200 PLC 1214C DC/DC/DC with most current firmware version or approved equal
  - b. APC Smart-UPS RT 1500VA with Smart-UPS (spare) Battery Pack uninterruptible power supply unit or approved equal
  - c. 8-Port Unmanaged Ethernet switch

- d. Siemens 15" HMI Operator Panel or approved equal
  - e. 4RF Aprisa SR+ Remote Station radio or approved equal
  - f. Two (2) Power Supplies
  - g. One (1) Siemens TIA Portal V15 Professional Floating License
2. The SCADA communications systems shall be as indicated on the drawings and as follows:
- a. Between the existing 0.5 MG Reservoir site and the new Hawi Well site.
  - b. Between the new Hawi Well site and the existing DWS Waimea Baseyard.
  - c. The system shall be used for transmitting alarms, status and telemetry, calculated data, diagnostic and error logging information from the PLC to the data logging system in the SCADA system.
  - d. Contractor shall coordinate the planning and construction of the SCADA system (programming, I/O list, etc.) with the Owner.
  - e. The Contractor shall furnish and install a SCADA ready enclosure as indicated on the plans and specified herein.
  - f. Contractor shall furnish a list of SCADA points for approval prior to fabrication of the SCADA PLC panel.
- C. This system shall be an integrated system of hardware and firmware totally engineered, programmed, assembled and tested. System shall be complete with all appurtenances, whether specifically referenced herein or not, but which may be required for operation.
- D. Programming: SCADA programming shall be provided and installed by the Owner. Contractor shall be responsible for providing the Owner's Electronic Technicians all requested information in a timely manner and a minimum of two (2) months notice prior to the project completion date to initiate programming services. If Contractor fails to provide sufficient notice to the Owner, the Contractor shall be solely responsible for all assessed liquidated damages should the Owner's Electronic Technician's exceed the project completion date in development and installation of the SCADA programming.
- E. During bidding and construction, Contractor shall coordinate his work with other trades to avoid omissions and overlapping responsibilities. Electrical contractor shall notify other trades and suppliers of project voltages, including control voltages.
- F. Work by Others: Instrument transmitters shall be provided by respective sections of this contract. Installation of equipment complete with power wiring and electric controls and interlock wiring shall be part of Electrical Work.



- 1.3 SUBMITTALS: Submittals shall be made for approval and resubmitted until approval is received for the following:

Furnish submittal information on the following items:

- A. Catalog Cuts: Submit for approval four (4) copies of catalog cuts of following equipment bound in white, three ring, hanging binders, Wilson Jones (W393-14W, W365-44W, or W365-49W) and labeled with project title on front cover and spine:
1. SCADA system components and equipment.
  2. Conductors and Wiring.
  3. Wiring and functional or block diagrams.
  4. Radio equipment including transmitters, receivers, antennas, antenna cables, etc.
  5. Manufacturer's recommendations for installation.
  6. Logic diagrams and ladder diagrams.
  7. Manufacturer's recommended list of spare parts for a one-year period of operation.
- B. Electrical Installation Drawings: At least 15 days prior to any testing the Contractor shall submit four (4) sets of approved complete electrical installation drawings. The installation drawings shall include the manufacturer's wiring diagrams for the SCADA system and any built-to-order equipment.
- C. As-Built Drawings: Upon completion of the final inspection and testing, the Contractor shall trace each wire, noting wire label and function. Based on notes generated, Contractor shall make necessary corrections to the design drawings and provide four (4) copies of as-built installation drawings and manufacturer's wiring diagrams for the SCADA ready enclosure and any built-to-order equipment, one (1) copy shall be printed on paper vellum or as laminated, to be used as the field reference. Additionally, Contractor shall provide two (2) copies of all "As-Built" drawings and diagrams on CD-ROM in both searchable PDF and DWG formats.
- 1.4 LOCAL SUPPORT: The manufacturer of the SCADA system supplied shall be represented by a company with offices in the State of Hawaii. This local office shall be capable of responding to requests for maintenance and repair to the system by having a technician skilled in the repair, maintenance and operation of the system at the job site within 24 hours of being notified. This local representative shall carry all spare parts which are recommended by the manufacturer.

## PART 2 - PRODUCTS

### 2.1 GENERAL

Unless otherwise indicated, provide all first quality, new materials, free from any defects,

in first class condition, and suitable for the space provided. New old stock materials shall not be furnished as new material and shall not be accepted. Provide materials approved by UL wherever standards have been established by that agency. Where two or more units of the same class of material or equipment are required, provide products of a single manufacturer. Component parts of materials or equipment need not be products of the same manufacturer.

## 2.2 STANDARD PRODUCTS

Unless otherwise indicated, provide materials and equipment which are the standard products of manufacturers regularly engaged in the production of such materials and equipment. Provide the manufacturer's latest standard design which conforms to the specifications.

## 2.3 EQUIPMENT FINISH

Electrical equipment may be installed with manufacturer's standard finish color, except where specific color, finish, or choice is indicated. If the manufacturer has no standard color, equipment shall be painted ANSI #61, Light Gray.

## 2.4 MATERIALS AND EQUIPMENT

- A. SCADA Ready Enclosure: The Contractor's SCADA work shall include terminating all telemetry inputs and outputs to terminal blocks within the SCADA enclosure as specified herein. Termination to an intermediate SCADA terminal cabinet shall not be accepted. Wiring shall be direct to SCADA enclosure. Termination shall be maintained tight to top, front of the enclosure's left side. Terminal blocks shall be neatly aligned in a single column and arranged in the following sequence from top to bottom: Power (Line), Power (Neutral), Power (Ground), Digital Inputs, Digital Outputs, Analog Inputs, and Analog Outputs. Terminal blocks shall be color coordinated in the following patterns:

## SCADA ENCLOSURE TERMINAL BLOCK SCHEDULE

DESCRIPTION	COLOR	PART #
POWER (LINE)	BLACK	PHOENIX CONTACT UT4, 3045143
POWER (NEUTRAL)	WHITE	PHOENIX CONTACT UT4, 3045130
POWER (GROUND)	GREEN	PHOENIX CONTACT UT4, 3045156
DIGITAL INPUT	YELLOW	PHOENIX CONTACT UTTB4, 3035467
DIGITAL OUTPUT	GRAY	PHOENIX CONTACT UT2.5 - 3L, 3214259
ANALOG INPUT	BLUE	PHOENIX CONTACT UTTB4, 3044791
ANALOG OUTPUT	BLACK	PHOENIX CONTACT UTTB4, 3074282
ANALOG GROUND	GREEN	PHOENIX CONTACT UT2,5-PE 3044092
SPACER	RED	PHOENIX CONTACT UT4, 3045127

Terminal blocks shall maintain one block spacing between groups, with exception for Power (Line), Power (Neutral) and Power (Ground) which shall be grouped together. Further, Digital Input, Digital Output, Analog Input and Analog Output shall be segmented into groupings of eight (8) blocks with one block spacing between groupings. Provide ground terminal blocks for each Analog Input and Analog Output for landing the shield wire.

Contractor's wiring shall be terminated to left side of terminal blocks, with negative on the base tier and positive on the top tier for double-level terminal blocks; with normally open (N.O.) on the base tier, common on the 2<sup>nd</sup> tier, and normally closed (N.C.) on the top tier for multi-level terminal blocks. Wiring shall be marked at both ends with printed wire labels or printed heat shrink tags. Wiring shall be color coordinated as follow:

## SCADA ENCLOSURE WIRING SCHEDULE

DESCRIPTION	COLOR
POWER (LINE)	BROWN
POWER (NEUTRAL)	WHITE
POWER (GROUND)	GREEN
D.C. (+)	RED
D.C. (-)	BLACK
DIGITAL OUTPUT (N.O.)	PURPLE

DIGITAL OUTPUT (COMMON)	YELLOW
DIGITAL OUTPUT (N.C.)	ORANGE
ANALOG INPUT (+)	BLUE
ANALOG INPUT (-)	GRAY
ANALOG GROUND	GREEN
ANALOG OUTPUT (+)	BLUE
ANALOG OUTPUT (-)	GRAY
ANALOG GROUND	GREEN

SCADA enclosures for installation within a control building shall be free standing, NEMA 12, mild steel, single door, single access, 90”H x 30”W x 30”D in dimensions with interior painted Hoffman #60 White and exterior painted ANSI #61 Light Gray.

Enclosure shall be furnished with one (1) half height swing-out panel, to be installed as specified in drawings; two (2) pairs of half length U Type RA 19” rack angles, to be installed as specified in drawings; one (1) side panel, 78”H x 20”W in dimensions, Hoffman A90SMP20, installed on left side of enclosure; and one (1) half length back panel, installed as specified in drawings. Enclosure door shall be right handed with left hand reverse swing, unless specified otherwise and include one (1) HMI touch panel installed with center of HMI panel at centerline width of enclosure and 60” above floor; and one (1) data port, Grace Engineered Products, Grace Port P-R2-K3RF3, which includes provisions for one (1) RJ-45 Ethernet port, two (2) GFCI 120 VAC outlets on the front, one (1) GFCI 120 VAC outlet on the back, with a 3 amp circuit breaker, housed within a UL panel-mount housing, installed with center of data port at centerline width of enclosure and 37.75” above floor. An additional metal framing channel, matching dimension of the existing metal framing channel, shall be welded 1” below existing channels, for both the center and bottom channels on the left and right side of the enclosure. A channel support frame including channel braces and angle brackets shall be provided for supporting the rack angles on the left side of the enclosure. Reference drawing for channel support frame dimensions. Ethernet radio shall be mounted to custom 19” rack panel on front of rack mount frame with four (4) #10 – 32 x 1/2”, 18-8 stainless steel, button head socket cap screws. The bottom 10U of rack space shall be reserved for one (1) uninterruptible power supply (UPS) and four (4) back-up batteries below. UPS and back-up batteries shall be mounted to rack mount frame with equipment slides, Hoffman A16SL2U. Contractor shall provide one (1) UPS and one (1) back-up battery. UPS shall be APC Smart-UPS RT 1500, SURTA1500RMXL2U. Back-up batteries shall be APC, SURTA48RMXLBP2U. As applicable, power supply for reservoir level transmitter shall be connected to UPS, so monitoring of reservoir level shall remain uninterrupted during a power failure event. With respects to the specified line item within the Proposal section, either PLC half panel or PLC full panel shall be installed on the enclosure’s back panel with four (4) 3/8” – 16 x 1-1/8”, 18-8 stainless steel, socket head cap screws, respectively. If a PLC dual panel is required,

the first panel shall be installed on the enclosure's back panel in the same manner as the PLC full panel, and the second PLC panel shall be installed on the rear side of the swing-out half panel to four (4) 3/8" – 16 x 5/8" (1/2" OD), 18-8 stainless steel standoffs, capped on front side of swing-out rack mount frame with 3/8" – 16 x 3/4", 316 stainless steel, high crown acorn nuts. Second PLC panel shall be mounted to standoffs with four (4) 3/8" – 16 x 3/4", 18-8 stainless steel, socket head cap screws. Enclosure shall also include a grounding strip.

B. SCADA Panel: Contractor shall furnish pre-fabricated PLC panel(s) as specified herein. Panel furnished for facility shall be one of the three standard Department of Water Supply designs. Selection of appropriate design shall be based on the analog and digital I/O required for the facility's present and known future requirements. Pre-fabricated PLC panels shall be assembled by a panel shop meeting the following requirements:

1. Shall possess a UL File Number for fabrication of UL508A and UL698 control panels for a minimum of 5 years. A copy of the panel shop UL File Number shall be submitted with the bid submission.
2. At the time of bid, shall have on staff a License Professional Electrical Engineer with the minimum license requirements as follows:
  - a. Electrical Engineering license in the State of Hawaii (HI) for a minimum of 5 years.
  - b. Electrical Engineering license for a minimum of 10 years.
  - c. Shall submit a copy of Electrical Engineering license for the State of Hawaii with bid submission.
3. At the time of bid, shall have on staff a CAD draftsman proficient in AutoCAD version 2013.

Panel shop shall fabricate PLC panel(s) on an anodized aluminum sheet (clear) 40.25" x 21.75" x 0.375" in dimensions. DIN rails shall be cut to length and installed on panel board as indicated on drawings. All DIN rails shall be installed regardless of whether populated by components or vacant. All DIN rails shall be mounted to 1/8" x 1-1/2" 6061-T6 aluminum flat stock, then mounted to panel on risers to elevate DIN rails and provide 1/2" clearance from panel surface. DIN rails shall be mount to panel board with 304 stainless steel, #10 – 24 x 1" button head, cap machine screws with plastic or rubber flat washers to prevent galvanic corrosion between dissimilar materials. Components shall be equipped to panels as required for facility and installed within their designated sections from top to bottom, left to right as indicated on the drawings. Terminal blocks shall be color coordinated in the following alternating patterns.

Terminal blocks, fusing terminal blocks, and interposing relays shall be segmented into groupings of eight (8) blocks or block pairs as applicable with one (1) block

spacer between groupings. Grouping of one (1) fusing terminal block with one (1) interposing relay and two (2) terminal block shall be considered as one block set.

#### SCADA PANEL TERMINAL BLOCK SCHEDULE

DESCRIPTION	COLOR	PART #
POWER (LINE)	BLACK	PHOENIX CONTACT UT4, 3045143
POWER (NEUTRAL)	WHITE	PHOENIX CONTACT UT4, 3045130
POWER (GROUND)	GREEN	PHOENIX CONTACT UT4, 3045156
POWER DISTRIBUTION	RED/BLACK	PHOENIX CONTACT UT4, 3045127 / 3045143
DIGITAL INPUT	YELLOW/WHITE	PHOENIX CONTACT UT4, 3045114 / 3045130
DIGITAL OUTPUT	GRAY	PHOENIX CONTACT UT2.5-3L, 3214259
ANALOG INPUT	BLUE/WHITE	PHOENIX CONTACT UT4, 30447941 / 3045130
ANALOG SHIELD DRAIN	GREEN/YELLOW	PHOENIX CONTACT UT2,5-PE, 3044092
ANALOG OUTPUT	ORANGE/WHITE	PHOENIX CONTACT UTTB4, 3045101 / 3045130
ANALOG SHIELD DRAIN	GREEN/YELLOW	PHOENIX CONTACT UT2,5-PE, 3044092
SPACER	RED	PHOENIX CONTACT UT4, 3045127

Wiring for SCADA panel shall be stranded conductor with cross-linked polyethylene insulation, UL AWM 3173. Wiring shall be sized 18 AWG with exception for power and power distribution wiring which shall be 16 AWG. Wiring shall be neatly installed with clean 90° bends, logical wiring paths, and bundled in logical groupings with wire ties. Wiring shall be routed behind DIN rails for efficient wiring layout.

Wiring shall be color coded according to following schedule, label over the entire length of wire with wire printer, and marked at both ends with printed heat-shrink wire tags.

#### SCADA PANEL WIRING SCHEDULE

DESCRIPTION	COLOR
POWER (LINE, 120VAC)	BROWN
POWER (NEUTRAL, 120VAC)	WHITE
POWER (GROUND)	GREEN
D.C. (+)	RED

D.C. (-)	BLACK
DIGITAL OUTPUT (N.O.)	PURPLE
DIGITAL OUTPUT (COMMON)	YELLOW
DIGITAL OUTPUT (N.C.)	ORANGE
ANALOG INPUT (+)	BLUE
ANALOG INPUT (-)	GRAY
ANALOG OUTPUT (+)	BLUE
ANALOG OUTPUT (-)	GRAY

Wiring rails fabricated from 6061-T6 aluminum flat stock, 1/8" x 1-1/2" x 40-1/4" in dimensions shall be installed on the left and right side of the panel on top of the DIN rails and flush with the edge of the panel board. Each wiring rail shall be mounted with three screws, with holes counter sunken so screw head sit flush to wiring rail surface.

- C. Operator Interface Touchscreen shall be installed within the SCADA Enclosure door, such that it may be operated without opening the cabinet door. Contractor shall confirm mounting location height with Manager or inspector prior to installation. Touchscreen shall have basic color screen.

Touchscreens shall monitor and control local functions of the PLC and communicate to the PLC using Ethernet communication, through a DIN rail mounted switch in the PLC panel.

The Touchscreen assembly shall be manufactured by Siemens and rated NEMA 4X. For facilities which only include a reservoir, a 10" Siemens KTP HMI panel with 640x480 resolution shall be specified. All other facilities shall use a 15" Siemens TP HMI panel with 1024x768 resolution.

- D. SCADA Hardware: The Contractor shall utilize as required the following list of approved PLC hardware. Hardware shall be the latest version at the time of construction, during the commencement of electrical portion of work.

1. Siemens S7-1200 1214C DC/DC/DC Firmware  $\geq$  4.1, CPU
2. Siemens SM1221, Digital Input
3. Siemens SM1222, Digital Output
4. Siemens SM1231, Analog Input 8AI
5. Siemens SM1232, Analog Output

6. Siemens PM1207, Power Switch
7. Siemens XB008, 8-Port Unmanaged Industrial Ethernet Switch
8. Siemens TP1500, 15" Panel
9. Siemens KTP1000, 10" Panel
10. 24VDC, 3.5A Power Supply, Phoenix Contact QUINT-PS/1AC/24DC/3.5, PN# 2866747 (for radio and level transmitter only)
11. 24VDC, 5A Power Supply, Phoenix Contact QUINT-PS/1AC/24DC/5, PN# 2866750 (for radio and level transmitter only)
12. DIN Rails, 35mm x 7.5mm x 2000mm, Aluminum, Phoenix Contact PN# 0804681
13. Terminal Block, Black, Phoenix Contact UT4, PN# 3045143
14. Terminal Block, White, Phoenix Contact UT4, PN# 3045130
15. Terminal Block, Green, Phoenix Contact UT4, PN# 3045156
16. Terminal Block, Red, Phoenix Contact UT4, PN# 3045127
17. Terminal Block, Blue, Phoenix Contact UT4, PN# 3044791
18. Terminal Block, Yellow, Phoenix Contact UT4, PN# 3045114
19. Terminal Block, Gray, Phoenix Contact U2.5-3L, PN# 3214259
20. Terminal Block, Gray w/Black, Phoenix Contact UT2.5-3L, PN# 3214262
21. Fuse Terminal Block, Phoenix Contact, UK63-HESI, PN# 3004171
22. 1 Pole, 120/240VAC, 10A, Circuit Breaker, Rockwell 1489-A1C100
23. 2PDT, 24VDC Coil, 10A, Rockwell PN# 700-HC22Z24-3-4
24. Screw Terminal Base Socket, Black, Rockwell PN# 700-HN128
25. Relay Retainer Clips, Rockwell PN# 700-HN114
26. Diode, Motorola 1N4005
27. Terminal Block – Grounding Green/Yellow Phoenix Contact UT2,5-PE
28. Siemens 1241 Communications Module RS485/422 Modbus

E. Radio Equipment and Communications



1. Communications: The Contractor shall take complete responsibility for the system communication. The initial investigation has determined that the radio frequency in the VHF range to transmit from the new Hawi Well site to the existing DWS Waimea Baseyard site would be the most efficient method of communications. The Contractor shall take the responsibility of checking out and verifying this mode of communication.
    - a. Communication Path Survey: Based on the coordinates and elevations of the various remote sites, the Contractor shall perform and furnish a computerized paper path survey to determine the gain margin for each proposed transmission path. The survey should simulate use of actual frequency and proposed equipment.
      - 1) The survey shall include but not be limited to: a printout graph for each communication path which shall show the path profile, site elevations, site name, frequency, ERP, antenna type, distance between sites and predicted losses versus desired losses. The Contractor shall design the radio and communication system for at least 99.9% reliability.
      - 2) Radio Path Study: A real world field study shall be performed by the Contractor to confirm the simulated computer path analysis. A representative of DWS shall be present for any radio path study field work.
  2. Licensing: The Contractor shall be responsible for consulting with DWS for instruction on which existing FCC license and frequency to use. The Contractor shall prepare all paperwork required for FCC coordination and FCC licensing in accordance with the FCC Rules and Regulations governing the licensing of the proposed channels. One VHF frequency shall be required to accommodate the PLC reception and transmission to the central computer. The Contractor shall submit all FCC coordination requirements to the FCC for frequency approval. The Contractor shall be responsible for the payment of FCC license fee.
  3. FCC Type Acceptance: All equipment related to the radio communication shall be FCC type accepted, indication authorization by the FCC to allow the equipment to be used by the licensee.
- F. Radio Equipment: The Contractor shall furnish and install latest edition 4RF Aprisa SR+ Remote Station radios as required by the Hawi Well project. As a minimum, communication equipment and grounding shall be per *Motorola R56 – Standards and Guidelines for Communication Sites*. All existing communication equipment, materials and appurtenances shall be replaced. The reuse of existing materials shall be strictly prohibited.
- G. Antenna and Accessories: All antenna hardware shall comply with FCC rules and governing the design characteristics and mounting requirements for licensed frequencies used in the SCADA system. In general, the remote station shall employ directional gain antennas. The central computer site will use an omni-directional gain antenna. Feedlines

between antenna and SCADA ready enclosures shall be solid, shielded coax (minimum 1/2" in diameter), low density, foam heliax. Each coax run shall be continuous and shall terminate with factory-installed connectors which are specifically designed for use with the above-described cable. The coax shall be run through conduit between the SCADA ready enclosure and the antenna. The conduit shall be a minimum of 3" nominal diameter, with no more than two (2) 90 degree bends with a minimum bend radius of 36 inches. The SCADA ready enclosure shall be equipped with a combination lightning arrestor and bulkhead fitting to allow coax termination through the enclosure. The feedline signal loss shall not exceed 1.55 dB (VHF) for each one hundred feet of run. The total connector loss at each site shall not exceed 1.0 db.

1. Grounding hardware kits specifically designed for use with the cable selected shall be furnished and installed by the Contractor.

a. Antenna Specifications:

Frequency Range	Match licensed channels
Nominal Impedance	50 Ohms
Forward Gain	6 -10 dB (Yagi) 3 - 6 dB (Omni)
Polarization	Vertical
Power Rating (min)	200 Watts
Materials	Aluminum/Stainless Steel
Construction	Welded
Mounting Clamps	3" O.D. Galvanized Pipe
Wind Rating	125 mph, 90 mph w/1/2" ice
Termination	Captive Type N
Lightning Protection	Direct ground connection

- H. Radio Hardware: The Contractor shall utilize as required the following list of approved PLC hardware. Hardware shall be the latest version at the time of construction. Provider shall provide one complete set of spare equipment.

1. 4RF Aprisa SR+ Remote Station Radio with Software Selectable Dual/Single Antenna Port
2. VHF Omni Antenna, 167-174 MHz, 6.0 dB, Laird FG1683
3. VHF Yagi Antenna, 167-174 MHz, 9.5 dB, 6 element, Laird Y1503
4. 1/2" Helical Coaxial Cable, Andrew LDF4-50a
5. 1-1/4" Helical Coaxial Cable, Andrew AVA6-50
6. 7/8" Helical Coaxial Cable, Andrew AVA5-50
7. Theft Deterrent Grounding Bar, Wireless Solutions HLGB-0412TSDNR-NH

8. 1-1/4" Coaxial Cable Grounding Kit, Sure Ground 114-06B2A
9. 7/8" Coaxial Cable Grounding Kit, Sure Ground 78-12B2U
10. 1/2" Coaxial Cable Grounding Kit, Sure Ground 12-12B2U
11. Lightning Arrestor, PolyPhaser VHF50HN
12. 3" Diameter Galvanized Round Utility Pole, 25' – 0"
13. 900 MHz Yagi Antenna Elpro YU6-900, 9 dB Gain
14. Elpro 905U-1-900 Spread Spectrum Radio

### PART 3 - EXECUTION

#### 3.1 CONSTRUCTION METHODS:

- A. Flush mount indicators, selector switches, pushbutton switches, and pilot lights in a logical arrangement.
  1. Mount devices listed, shown, or required for a complete and operable system in accordance with device manufacturer's instructions, these specifications, and as recommended in NEMA PB1.1.
  2. Ground control panel to safety ground of power source.
  3. Analog signals must use shielded pairs cabling.

#### 3.2 PROGRAMMING:

- A. Contractor shall coordinate all PLC programming with the Owner.
- B. The PLC supplier and Contractor shall provide the complete PLC and HMI software with appropriate licenses and license keys programming and documentation for PLC to comply with the requirements set forth herein.
- C. Contractor shall provide Owner with a copy of the implemented software.

#### 3.3 COMMISSIONING: Instruments are to be commissioned under the direct supervision of a qualified representative of the instrument manufacturer. The Owner and or the Owner's representative shall have the right to witness any test, inspection, or calibration or start-up activity.

- A. Test and exercise each device to demonstrate correct operation, first individually, then collectively as a functional network. Apply continuously variable analog inputs to verify proper operation and setting of analog devices and discrete devices (i.e. switches, etc.).

Make provisional settings on relays and pressure switches.

- B. Unless otherwise specified, tests shall be made to cover at least five points: approximately 0 percent, 25 percent, 50 percent, 75 percent, and 100 percent of range. Individual device accuracy requirements shall be as specified by contract requirements or by published manufacturer accuracy specifications whenever contract requirements are not specified.
  - C. If test results conflict with calibration, the Contractor shall recalibrate and repeat test until test results prove calibration to be correct.
  - D. The supplier of all equipment shall be an organization which is committed to the provision of ongoing support and development and can show a history which supports this position. In particular, the supplier must so state in writing that they have performed 5 similar projects with this proposed configuration. It must support and use industry standards and be committed to the use of open standards. The supplier must perform all work within the State of Hawaii.
- 3.4 TEST REPORT: Prepare a test report showing actual value, instrument value, 4-20 mA value (at the PLC) for each test, and range of the instrument. Each test shall bear the signature of the contractor's representative who supervised the tests and the manufacturer's representative. Three copies of these reports in bound sets label "CALIBRATION DATA" are to be furnished to the Owner's Representative.
- 3.5 ADDITIONAL START-UP SERVICES: The Contractor shall include an additional two days of programming time and the cost for the PLC's programmer to visit the site for one of the days in the bid. This time may be used at the discretion of the Owner for additional programming, changes, and/or training. This time is over and above the work necessary to provide a complete and operable system.
- 3.6 GUARANTEE: The SCADA system, equipment, materials, and associated items shall be guaranteed against defective parts and operation due to faulty material or workmanship during the period of one year following acceptance and final payment by the Developer. The Contractor shall make all repairs or replacements necessary to accomplish the required performance within the time specified by the Developer and agreed to by the Contractor.
- 3.7 MEASUREMENT AND PAYMENT: The SCADA work shall be measured and paid for at the contract lump sum price bid.
- A. General: No separate payments will be made for the work covered by the separate section of the 16100 series of these specifications. All costs in connection with furnishing and installing of the various items in accordance with standard practice, the details shown on the drawings and in accordance with these specifications, shall be included in the lump sum price of which the item is a part.
  - B. Compensation: Payment of the furnishing and installing of equipment will be made at the lump sum price bid of which the item is a part and shall be full compensation for all work in accordance therewith, complete and finished in accordance with the drawings and

specifications.

- C. Payment to the Contractor will be made in two (2) parts once all work is in place, complete, and the SCADA System is operational.
1. The first part will be fifty percent (50%) of the contract Proposal Item No. 3 & No. 6 under Electrical Work Lump Sum price, when all original manufacturer's software and licenses, all programming software, all operational manuals, written procedures, and all other related documents for the operation of the SCADA system are submitted to the Owner.
  2. The second part will be fifty percent (50%) of the same Lump Sum price when the SCADA System is operating satisfactorily for 60 days continuously after the project is officially accepted by the Owner.

END OF SECTION

## SECTION 33 11 41

### VERTICAL TURBINE PUMPING UNIT

#### PART 1 – GENERAL

- 1.1 This section of the specifications provides a description of the requirements for the well pump. The Contractor shall be responsible for furnishing new material. The Contractor shall field verify the indicated dimensions and be responsible for proper fit of the pump installation.
- 1.2 All work covered by this section of the specifications shall be done by a Contractor holding a C-57 Well Drilling Specialty License from the State of Hawaii and the burden of proof shall rest with the Bidder
- 1.3 All new metal items including factory painted items shall be painted as specified in the Water System Standards, Honolulu Board of Water Supply, 2002 and all subsequent amendments herein after referred to as the Water System Standards. Payment for painting work shall be part of the unit price bid or lump sum bid, whichever is specified, for the item of which it is a part.
- 1.4 Contractor shall field verify Well Data shown on the construction plans and provide updated drawing after inspection. The Contractor shall verify the well inside diameter before ordering the pump. It is the Contractor's responsibility to provide the right size pump for a complete installation and operation.
- 1.5 Operation of the deepwell pumping system is to be automatic. The pump shall be started and stopped by the reservoir level controller or by supervisory control from a representative designated by the DLNR. Manual controls shall also be provided at the pumping unit.

The pumping unit shall be started with the pump control valve open. After oil pre-lubrication and a selectable time delay, the pump control valve slowly closes, and flow is established to the system. Under normal shut down conditions, the pump control valve shall slowly open, with the pump unit continuing in operation. As the pump control valve nears its fully open position, it shall trip a microswitch shutting down the pumping unit. Opening and closing speed control valves shall be provided to adjust the opening and closing speed of the pump control valve, thereby limiting line pressure fluctuation to a minimum.

#### PART 2 – PRODUCTS

##### 2.1 PUMP BOWL ASSEMBLY:

- A. Number Required: One (1)

Vertical Turbine Pumping Unit

33 11 41-1

Job No.

Upolu Well Development, 593' 0.5MG Reservoir,  
and Transmission Main

B. Pump rated capacity and head:

1. 395 gpm at 640 feet head
2. Minimum guaranteed overall efficiency of pump bowl assembly at rated capacity and head when tested at the factory shall be 75 percent. Pump test shall conform to Section 2.12.

C. Example of pump performance characteristics desired:

1. 0 gpm at 997 feet head
2. 200 gpm at 865 feet head (Bowl efficiency not less than 64%)
3. 300 gpm at 776 feet head (Bowl efficiency not less than 77%)
4. 500 gpm at 450 feet head (Bowl efficiency not less than 66%)

D. Maximum shut-off head:

1. 997 feet

E. Pump used to specify pump performance Characteristics:

1. Weir Floway 8JKH (25 stages)
2. Contractor shall verify the well inside diameter before ordering the pump. It's contractor's responsibility to provide a right size pump for a complete installation and operation.

F. Maximum pump speed:

1. 1800

2.2 MOTOR: The existing motor shall be replaced with a new motor.

- A. Number required: One (1)
- B. Minimum horsepower rating: 100
- C. Power: 460 volts / 3-phase / 60 Hz
- D. Enclosure: Weather Protected NEMA Type 1 (WP1)
- E. Minimum full load motor efficiency: 90%

Vertical Turbine Pumping Unit

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Job No.

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and Transmission Main

F. Maximum speed of motor: 1800 RPM

G. Minimum motor service factor: 1.10

2.3 MOTOR DRIVE SHAFT:

A. Provide new motor drive shafts. The drive shaft shall connect the new head shaft with new motor-pump coupling.

B. The drive shaft shall be ground and polished Type 416 stainless steel conforming to ASTM A582. The shaft shall be furnished in a length to fit the new motor. A suitable method shall be provided on the top end of the shaft to allow for impeller adjustment by means of an adjusting nut. The nut shall be provided with a positive locking device.

2.4 DISCHARGE HEADS:

A. Surface Discharge Head:

1. Size of discharge flange: 8 inches

2. Class of pipe flange:

250 lb. ANSI B16.1,

Contractor to verify and match existing flange class.

3. See Section 2.7.D.2

B. Head Shaft:

The new shaft in accordance with Section 2.7.D.3

2.5 DISCHARGE COLUMN ASSEMBLY:

A. Discharge column pipe and column adapter size:

1. Pipe and column adapter size:

8 inches

2. Minimum pipe wall thickness:

0.322 inches (Schedule 40)

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3. Approximate length of new replacement discharge column piping and column adapters to be field verified:

588 feet

4. See Section 2.7.C

B. Enclosed line shaft and shaft enclosing tube:

1. Minimum enclosed line shaft size:

1.25 inches

2. Enclosed line shaft and coupling material:

ASTM A108 grade C1045

3. Shaft Enclosing Tube Material:

ASTM A120 Schedule 80 steel pipe

4. Line Shaft Bearings:

ASTM B584 C93200 bronze

5. Approximate length of new line shaft and couplings to be field verified:

590 feet

6. See Section 2.7.C

2.6 AIR LINE:

Air lines are contractor supplied/installed and are not part of the pump manufacturer's materials.

In the Well:

- A. Elevation of bottom of air line:

-15.0 ± feet

- B. Material: 1/4 inch extra strong, Schedule 80, brass pipe.

- C. Approximate length in well to be field verified: 583 feet

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The Contractor shall field-measure the new air line during installation and provide the Engineer with the installed length, as referenced from the top of the pump base to the nearest 0.10 feet.

D. See 2.7.C.6

Outside of Well:

The air line installed underground between that in the well and the gauge board shall be 1/4-inch soft copper water tubing, type L. The line shall be installed in a 2-inch PVC conduit a minimum of 12 inches below the ground surface. The airline installed in the gauge board shall be 1/4-inch soft copper water tubing, Type K.

2.7 PUMPS:

The vertical turbine pump shall be of the multi-stage type manufactured by Xylem Goulds Pumps, Floway, Byron Jackson, National Pump Company or an NSF 61 certified approved equal.

The manufacturer of the pump bowl assembly shall be certified by the International Organization of Standards (ISO) as conforming to the requirements of the ISO 9000 series standards.

The pump bowl assembly shall be customized (impeller-trimming), assembled, and tested at the manufacturer's facility certified by the International Organization of Standards (ISO) as conforming to the requirements of the ISO 9000 series standards.

Each pumping unit shall consist of a motor, a pump bowl assembly, a discharge column assembly and a discharge head assembly.

The pumping unit shall conform to the standards set for by “NSF/ANSI Standard 61: Annex G certified, or both NSF-61 certified and NSF-372 certified. Certification will only be accepted from the following American National Standards Institute (ANSI) accredited third-party certification bodies: NSF International, UL, IAPMO R&T Inc., ICC-ES, Intertek, Truesdail, WQA, or CSA Group.

The pumping unit supplied shall conform with these specifications and the “American National Standard for Deepwell Vertical Turbine Pumps – Line Shaft and Submersible Types”, ANSI B58.1 as last revised. These specifications shall serve as a complement to ANSI B58.1 and, where contradictions occur, these specifications shall govern. These specifications indicate minimum material quality and performance required.

A. PUMP BOWL ASSEMBLY

The pump bowl assembly shall consist of the pump bowls, impellers, shaft, suction case, discharge case, and strainer.

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The pump manufacturer shall provide enough clearance in the pump bowls to allow for any shaft stretch under any operating condition without the impeller making contact with the bowl.

1. Pump Bowls:

The pump bowls shall be designed for a minimum pressure of 300 psi and shall be made of close-grained cast iron, free from blow holes, sand holes, and other defects. The bowls shall conform to ASTM Designation A48, Class 30 or better, as required, with a minimum tensile strength of 30,000 pounds per square inch. The bowls shall be capable of withstanding a hydrostatic pressure equal to the greater of either twice the pressure at the rated capacity, or 1.5x the pressure at shutoff. Each bowl shall be glass lined and accurately machined and fitted to close dimensions and fitted with bronze sleeve type bearings on each side of the impellers.

2. Impellers:

The impeller shall be of the fully enclosed type and shall be of silicon bronze UNS C87610, aluminum bronze UNS C95200, or other approved material, of heavy construction and free from blow holes, porosity and other defects. The impeller shall be finished all over, accurately fitted and perfectly balanced, both mechanically and hydraulically. Passages shall be smooth to assure efficient operation and to prevent air or sand locking. The impeller shall be locked securely to the shaft with keys, taper bushings, locknuts or set screws.

3. Impeller Shaft:

The impeller shaft shall support the impellers and shall be of ground and polished Type 416 stainless steel, ASTM A 582. The shaft shall be supported by suitable bronze sleeve type bearings on both sides of each impeller with positive means for water lubricating each bearing. The shaft shall be threaded at the lower end to receive an assembly nut to accurately locate the shaft with respect to the bowls during assembly of the bowl unit. The bottom case bearing shall be of UNS C89835 bismuth tin bronze or other approved material.

4. Suction Case:

The suction case shall connect the strainer to the pump bowls and house the bearing which supports the bottom portion of the impeller shaft. The suction case shall be of cast iron construction conforming to ASTM A 48, Class 30, properly designed to guide water from the well to the first impeller with minimum friction loss.

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and Transmission Main

5. Discharge Case:

The discharge case shall be of glass lined cast iron, ASTM A48, Class 30, and shall contain a bronze bearing to support the upper end of the pump shaft.

6. Strainer:

The strainer shall be of the cylindrical type. The strainer shall be directly attached to the lower end of the suction case or attached to the suction case by means of a short length of suction piping with suitable couplings. The suction piping shall not exceed one (1) foot in length and shall be of identical size and construction as the discharge column coupling.

The strainer shall be of galvanized steel construction. The net inlet area of the strainer shall not be less than three (3) times the suction case area. The maximum opening shall not be more than 75 percent of the minimum opening of the water passage through the bowl or impeller. The discharge case shall be of glass lined cast iron, ASTM A48, Class 30, and shall contain a bronze bearing to support the upper end of the pump shaft

B. TEFC MOTOR:

The electric motor shall be vertical hollow shaft with non-reverse ratchet, oil lubricated, P-base, squirrel cage induction design, NEMA premium efficiency. Enclosure shall be NEMA Weather Protected Type I with stainless steel screens over air inlet and outlet openings. Motor shall conform to the standards of the National Electrical Manufacturers Association and the American Institute of Electrical Engineers. The motor shall be designed for "soft start" starting, and capable of continuous operation under the head specified.

Motor shall be provided with Resistance Temperature Detection (RTDs) for Motor windings. Provide two 100 Ohm platinum RTDs per motor phase. Coordinate RTD system with electrical specifications.

The motor shall have a horsepower rating of not less than specified and shall not be loaded in excess of 95% of its nameplate rating at the rated head and capacity of the pump. Additionally, the motor shall not be loaded in excess of 100% of its nameplate rating at any condition from zero flow to the maximum capacity of the pump. The motor shall be capable of operating for a few minutes under shutoff head conditions.

Motor windings shall be encapsulated or sealed with epoxy according to NEMA standards by an insulation system such as Custom Polyseal or approved equal.

Motor shall be equipped with space heaters which shall operate only when the motor is not running, rated at 120 VAC, 1 PH, with wattage as required by the motor manufacturer. Space heater leads shall be brought into the motor terminal box or it

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shall have a separate terminal box of its own for conduit connection.

Thrust bearings shall be provided as an integral part of the motor and shall be of ample capacity to handle the continuous down thrust as specified by the pump manufacturer. The bearing shall be of such a size that the average life rating based on continuous operation is no less than five (5) years. The bearings shall also have the capacity to allow the pump to operate for at least ten (10) minutes with the discharge valve closed. The motor shall be designed to prevent reverse rotation when the unit is shut down.

Contractor shall be responsible for all modifications to insure proper fit and match for new motor on pump discharge head.

The motor shall be General Electric, U. S. Motors, or approved equal.

The motor shall be manufactured within the previous two (2) years of the date of this contract and the manufacturer's certificate of compliance shall be provided for DLNR approval.

C. DISCHARGE COLUMN ASSEMBLY:

The discharge column assembly shall consist of the discharge column pipe, enclosed line shaft, line shaft couplings, line shaft bearings, shaft enclosing tube and air line.

1. Discharge Column Pipe:

New discharge column pipe shall be Schedule 40 steel pipe conforming to ASTM Designation A 53, Grade B, size and thickness as specified, coated with zinc inside and outside by the hot-dip process or epoxy coated ID & OD with an NSF approved epoxy such as Carboline 891 or equal. Each section of column shall have straight threads with ends accurately machined to form a butt joint to insure accurately assembled column length and perfect alignment. The pipe shall be furnished in interchangeable sections of not more than ten (10) feet in length. The top end (attached to the discharge head bottom) and the bottom (attached to the top of the pump bowl assembly) of the discharge column pipe shall not exceed five (5) feet in length each.

2. Enclosed Line Shaft:

The enclosed line shaft shall be turned and ground; furnished in interchangeable sections having a nominal length of 10 feet. To insure accurate alignment of the shafts, they shall be straight within 0.005 inch total indicator reading for a ten (10) feet section; the butting faces shall be machined square to the axis of the shaft; the maximum permissible error in the axial alignment of the thread axis with the axis of the shaft shall be 0.002 inches in 6 inches.

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3. Line Shaft Coupling:

New individual sections of the line shaft shall be connected with turned and ground steel couplings. The couplings shall be designed with a safety factor of 1- 1/2 times shaft safety factor and shall have a left-handed thread to tighten during pump operations without distortion or vibrations.

4. Line Shaft Bearings:

The line shaft bearings, which are also integral tube couplings, shall be spaced not more than 5 feet apart. The bearings shall contain oil grooves or a separate bypass hole which will readily allow the oil to flow through and lubricate the bearings below.

5. Shaft Enclosing Tube

The shaft enclosing tube shall be manufactured with ends machined square and parallel, threaded internally to receive the line shaft bearings. Maximum tube runout in 5 feet length shall not exceed 0.005 inches. The shaft enclosing tube shall be provided in interchangeable sections not more than 5 feet in length.

6. Air Line:

The air line in the well is 1/4 inch, extra strong brass pipe and shall be terminated at the elevation specified. The airline shall be strapped to the pump column with stainless steel straps no more than ten (10) feet apart. The air line shall have machined couplings.

D. DISCHARGE HEAD ASSEMBLY:

The discharge head assembly shall consist of a head baseplate, head shaft, and a surface discharge head. Replace all existing mounting fasteners with new fasteners of equal quality, grade, etc.

1. Head Baseplate:

A base plate, of sufficient area and thickness to support the weight of the entire pumping unit, shall be furnished for mounting the surface discharge head. The base plate shall be of cast iron construction, free from blow holes, sand holes and all other detrimental defects and conform to ASTM A 48, Class 30. The base plate shall be accurately machines, drilled and tapped to fit the discharge head and shall be properly fitted in as a permanent part of the concrete pump foundation to prevent the entrance of water into the well. The opening of the base plate shall be of sufficient size to allow the installation of the pump bowl assembly, the discharge column assembly, the well level recorder air line, and the air relief valve.

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2. Surface Head Discharge:

The surface discharge head shall support the driver, the discharge column assembly and the pump bowl assembly and shall discharge water from the discharge column assembly. The discharge head shall be accurately machined of cast iron, free of sand holes and other defects. The discharge head shall be of fabricated steel construction conforming to ASTM A53 and incorporate a discharge elbow having an aboveground flanged outlet.

The discharge head shall be equipped with a tube tensioning device to apply and maintain proper tension to the shaft enclosing tube. This device shall consist of an ASTM A48 Class 30 cast iron tube tension plate and an ASTM B548 C83600 bronze combination tube tension nut and bearing. Tension shall be applied to the shaft enclosing tube through internal threads in the top tube.

The discharge head shall have two ½-inch NPT taps in the space between the well casing and the pump discharge column to allow connection of the air relief line and to permit passage of the well level recorder air line; one ¾-inch NPT tap for drain and another NPT tap for the lubrication line.

The pump shall be furnished with an aluminum nameplate securely mounted to the discharge head. At a minimum, it shall contain information providing:

- a) Design flow
- b) Design TDH
- c) HP, RPM
- d) Bowl model number, number of stages
- e) Manufacturer serial number
- f) Pump type & impeller setting dimension.

3. Head Shaft:

The new head shaft shall connect the line shaft to the driver. The head shaft shall be ground ASTM A108 C1045 carbon steel. The head shaft shall not be longer than ten (10) feet and shall be of the size as called for in these specifications. A suitable method shall be provided on the top of the head shaft to allow impeller adjustment by means of an adjusting nut. The nut shall be provided with a positive locking device. Straightness and machining tolerances shall be as specified under the “Enclosed Line Shaft” section of these specifications.

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2.8 PRE-LUBRICATION SYSTEM:

The discharge head shall be equipped with a standard four-quart oil reservoir fitted with a sight drip oiler and a solenoid valve for automatic lubrication. The pre-lubrication system and its components shall oil lubricate the stuffing box assembly in the discharge head and pump shaft bearings before startup and during pump operation. Lubrication shall stop when the pump shuts down. The lubrication system shall meet the following conditions. The pre-lubrication system and its components shall be installed by a contractor holding a current C57 Well Drilling Specialty License from the State of Hawaii. The Contractor shall be responsible for providing any additional valves, piping, parts, associated hardware, or modifications to the discharge head or discharge head connection that are not specified or shown in the drawings, necessary to provide acceptable lubrication onto the line shaft at no additional cost to the DLNR.

2.9 SPARE PARTS:

Each bidder shall include in his bid the cost of supplying and delivering the following list of spare parts to the DLNR:

- A. One (1) extra set of packing rings.
- B. One (1) extra set of bearings for one (1) motor.

2.10 SUBSTITUTION OF SPECIFIED PUMP:

If a specified pump model has been used to dimension plans and specify pump performance characteristics, a substitute pump can be used only if the following conditions have been met:

- A. All changes in dimensions resulting from the substitution of the specified pump shall be the responsibility of the Contractor. The substitution must be approved by the DLNR.
- B. The substitute pump shall have performance characteristics equal to or better than the specified pump. Performance characteristics that shall be compared are the required horsepower, efficiency and head-capacity curve.
- C. The DLNR shall approve the substitution before the substitute pump is ordered.

2.11 PRELIMINARY SUBMITTALS:

The Contractor shall obtain written approval from the DLNR prior to ordering the pumping unit. The DLNR reserves the right to reject any non-approved pumping unit that is ordered and require the Contractor to supply a different pumping unit that meets with DLNR's approval at no additional cost. To obtain approval to order the proposed pumping unit the

Vertical Turbine Pumping Unit  
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Contractor shall submit six (6) copies of the following to the DLNR:

A. Preliminary Pump Characteristics curves:

The preliminary pump characteristic curves shall show the proposed head, efficiency and brake horsepower vs. capacity of the pump to be furnished.

B. Pumping Unit Specifications:

The Contractor shall submit complete specifications for the pump and motor he proposes to furnish. All pumping unit material shall be specified.

C. Thrust Load Curves:

The Contractor shall supply with his proposal a curve showing the thrust load from shutoff head to the lowest head specified. The rating of the thrust bearing being furnished with the motor shall be shown as part of the data on the curve.

D. Motor Data:

The Contractor shall submit certified test data for motor A.C. winding resistance, no load current, full load current, locked rotor current, starting torque, motor efficiency at 50, 75, and 100% full load, power factor at 50, 75, 100% full load, and power factor at 90 and 110% rated voltage.

E. Discharge Column Joint Lock:

The method of locking the discharge column joints to prevent their loosening shall be submitted with the pump specifications.

F. Certification of Compliance with ISO 9000 Series Standards:

The Contractor shall submit certification that the pump and motor manufacturers is (are) registered/certified by the ISO as conforming to the requirements of ISO 9000 series standards.

2.12 MANUFACTURER LABORATORY PUMP TEST:

The Contractor shall obtain written approval from the DLNR of all curves and data sheets for each bowl assembly to be used before the pumps may be installed. The DLNR reserves the right to reject any pump that is installed for which the Contractor has not obtained approval for and require the Contractor to remove and replace the non-approved pump at no additional cost to the DLNR.

To obtain DLNR approval the Contractor shall submit six (6) manufacturer-certified copies of performance curves and test data sheets of the manufacturer's laboratory running test

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conducted for each bowl assembly furnished and witnessed by an independent engineering firm. The running test shall be conducted in accordance with the latest edition of the “American National Standard for Deepwell Vertical Turbine Pumps – Line Shaft and Submersible Types” ANSI B 58.1 to show that the specified conditions can be met by the bowl assemblies furnished. The performance curves shall show the head-capacity, efficiency-capacity, overall efficiency-capacity and required brake horsepower capacity curves for each bowl assembly.

2.13 CERTIFICATION OF DISCHARGE COLUMN PIPE:

The Contractor shall obtain written approval from the DLNR before the installation of any column pipe. The DLNR reserves the right to reject any non-approved column pipe that is installed and require the Contractor to remove and replace the non-approved column pipe with a column pipe that meets with the DLNR’s approval at no additional cost to the DLNR. To obtain approval the Contractor shall submit to the DLNR, a certificate verifying the following:

- A. The thickness of the discharge column pipe furnished is as specified.
- B. The pipe conforms to ASTM Designation A 53.

2.14 LAYOUT DRAWINGS:

The Contractor shall obtain written approval of the pump and piping layout drawings before any construction may begin. The DLNR reserves the right to reject any layout drawings that have not been approved and require the Contractor to revise the layout drawings at no additional cost to the DLNR. The Contractor, at no additional cost to the DLNR, shall redo construction work that is done prior to the DLNR’s approval of the layout drawings or that is not in accordance with the approved layout drawings. To obtain approval the Contractor shall submit six (6) sets of pump and piping layout drawings. All dimensions of pump, valves, piping, fittings and appurtenances shall be shown.

PART 3 - EXECUTION

3.1 INSPECTION OF EXISTING WELL AND INSTALLATION OF PUMPING UNIT:

The Contractor shall have an inspection of the existing well conducted before installing the pumping unit. The Contractor shall obtain written approval of the proposed inspection procedure from the DLNR before the inspection may be conducted.

The Contractor shall inspect the existing well for silting, caving-in and foreign materials before installing the pumping unit. The inspection shall include a visual inspection of the well by video camera lowered into the well.

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A written report stating the results of the inspection along with an updated layout drawing showing all elevations shall be submitted to the DLNR. The DLNR reserves the right to reject any inspection that is conducted without written prior approval and require another inspection to be conducted at no additional cost to the DLNR.

The Contractor shall be liable for any damages resulting from the installation of the pumping unit prior to the DLNR's approval of the inspection procedure. In the event deficiencies are observed, the Contractor shall take corrective measures, including, but not limited to, cleaning of the well.

Inspection of the existing well and the Installation of the pumping units shall be conducted by the same Contractor holding a current C- 57 Well Drilling Specialty License for the State of Hawaii. The installation shall be performed under the direction of the supplier of the pumping units, and be performed in the presence of the DLNR's Construction Inspector.

### 3.2 INSTALLATION INSTRUCTIONS AND MAINTENANCE MANUAL:

The pump manufacturer shall also provide at least six (6) copies of instructions for the installation of the pumping units and proper maintenance of the same. The manuals shall include tolerances and part numbers, and it shall be in bound folders.

A. Upon completion of installing the new pumping unit, the Contractor shall notify the DLNR for rotation testing of the new equipment. The Contractor shall coordinate testing of the new pump with the DLNR Inspector and DLNR Project Engineer. All testing shall be done in the presence of a DLNR Representative; failure to do so shall result in liquidated damages for failure to comply with specifications.

### 3.3 TESTING AND CERTIFICATION OF PUMP:

After installation of all machinery and other equipment in the well, a complete operating test of the pumping unit and other equipment shall be made over a test period of two (2) days or two complete pumping cycles, whichever lasts longest. The Contractor shall make his own arrangements and pay for power and other costs as required.

Throughout the operating test, the pumping unit shall run smoothly without vibration, leaks or heating of the bearings. If during or as a result of this test, any structural or mechanical defect or weakness develops, or if the equipment fails to deliver its required discharge at the respective head under required conditions, the DLNR reserves the right to reject any part or all of the equipment and demand reconstruction or replacement to meet the requirements of these specifications.

During the operating test, DLNR shall operate the new pump equipment and place the facility into service. The Contractor shall be on stand-by notice to repair any equipment defects that occur during the test period. Any repairs needed due to equipment and material defects shall be performed at no additional cost to the DLNR. Upon completion of

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necessary repairs, the Warranty period shall start over. The test period shall be repeated as necessary until the test period has passed free of defects and failures. After completion of the test period, Construction Branch will notify other divisions that final inspection has been completed.

During the period between the first test and the final acceptance of the pumping unit by the DLNR, the unit shall be left in place and in good working condition for use by the DLNR in order to provide service, if required and at no additional cost to the DLNR.

3.4 INSTALLATION OF VERTICAL TURBINE PUMP:

Installation of the vertical turbine pump shall be done for the Contractor by a DLNR approved subcontractor holding a current C-57 License. The equipment shall be installed only in the presence of the authorized DLNR representative.

The pump installer shall have a minimum of five (5) years of experience in the installation, testing, maintenance, and repair of vertical turbine deepwell pumping units of similar capacity, head, setting and horsepower as the pumping unit specified. The pump installer shall also have nearby plant facilities and equipment to immediately repair the pumping units should any emergency arise.

3.5 WELL COMPLETION REPORT:

After installation of the pumping unit, the Contractor shall complete a Well Completion Report and submit it to the State Water Commission Office.

3.6 PROJECT COMPLETION:

It shall be the Contractors responsibility to guarantee proper operation of all newly installed components, including compatibility with any reused or modified components of the pumping unit, having met all applicable tests prior to DLNR acceptance. It is the Contractor's responsibility to conduct all necessary field testing required by DLNR to prove proper operation of the newly installed components. After acceptance of the pump by the DLNR and throughout the warranty period, all troubleshooting, repairs, and replacements necessary to meet the rated capacity of the pumping unit and these project specifications is the responsibility of the Contractor, at no additional costs to the DLNR.

END OF SECTION

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## SECTION 33 11 43

### VALVES AND APPURTENANCES

#### PART 1 – GENERAL

- 1.1 This section of the specifications covers the Well Pump Control Valve, Well System Discharge Valve, NRS Gate Valve, Silent Check Valve, Lube Line Solenoid Valve, and Vacuum Release Check Valve.

A. Well Pump Control Valve

1. Number Required: One (1)
2. Size of Valve: 6-inch
3. Class of Flange 250 lb
4. Location: Well

B. Well Pump System Discharge Valve

1. Number Required: One (1)
2. Size of Valve: 8-inch
3. Class of Flange 250 lb
4. Location: Well

C. NRS GATE VALVE

1. Number Required: One (1)
2. Size of Valve: 6-inch
3. Class of Flange 250 lb
4. Location: Well

D. SILENT CHECK VALVE

1. Number Required: Two (2)
2. Size of Valve: 6-inch, 8-inch

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3. Class of Flange 125 lb

4. Location: Well

E. Pump Vacuum Release Check Valve

1. Number Required: One (1)

2. Size of Valve: 4-inch

3. Class of Flange 250 lb

4. Location: Well

F. Pre/Post Lube Line Solenoid Valve

1. Number Required: One (1)

2. Size of Valve: 1-1/2 inch

3. Class of Flange 125 lb

4. Location: Well

G. Flap Valve

1. Number Required: One (1)

2. Size of Valve: 6 inch

3. Class of Flange 125 lb

4. Location: End of 6-inch well discharge line

## PART 2 – PRODUCTS

### 2.1 LEAD FREE MATERIALS:

Provide NSF-61 certified products.

Contractor shall submit written proof of certification that all valves/valve coatings are either NSF-61 Annex G certified or both NSF-61 certified and NSF-372 certified. Refer to General Conditions spec section, under Quality of Materials for acceptable third-party certification bodies and other requirements.

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If the Contractor finds that there are no manufacturers that meet the above requirements, the Contractor shall notify DLNR. When an item has no manufacturers that meet this requirement, the item shall be lead-free in accordance with the Safe Drinking Water Act.

## 2.2 AMERICAN IRON AND STEEL REQUIREMENT:

All items in this section shall comply with the AIS (American Iron and Steel) provision, requiring all iron and steel products in this section to be produced in the United States.

Contractor shall provide valves that comply with AIS provisions. Should the below specified valves not meet the AIS provisions, the contractor shall notify DLNR and provide a valve that meets both the specification requirements and AIS provisions.

If the contractor finds that there are no manufacturers that meet both the specification and AIS provisions requirements for a particular item, the contractor shall notify DLNR.

## 2.3 WELL PUMP CONTROL SYSTEM:

- A. The deep well pump control system shall consist of a new pump control valve, a new system discharge valve, a new pump vacuum release check valve, and all necessary piping for a complete system.
- B. The system discharge valve shall have power check feature for this system.
- C. The well pump control system shall be designed to:
  - 1. Release air in the pump discharge column during well pump start.
  - 2. Break the vacuum in the pump discharge column during well pump shutdown.
  - 3. Eliminate objectionable pressure surges in the pipeline by controlling the opening and closing speeds of the system discharge valve during both well pump start and shutdown.
- D. General Operating Procedure:

- 1. Deep Well pump start procedure:

The pump control valve shall be open and the system discharge valve shall be closed when the well pump unit is not in operation. The pump shall not start without the system discharge valve's "closed" micro switch activated. When the well pump starts, the air and initial inrush of water from the well pump column shall be expelled through the pump control valve into the dump line. After a sufficient programmed duration of time, the pump control valve's solenoid valve shall be energized by the PLC control unit, causing the control valve to slowly close. As the pump control valve begins to close, its limit

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switch shall trigger the valve's solenoid valve, allowing the system discharge valve to slowly open.

The PLC control unit shall be programmed to shut down the well pump unit should either the pump control or system discharge valves fail to complete their sequences within the programmed timeframe.

## 2. Well Pump Shutdown Procedure:

The pump will be in operation. The pump control valve shall be closed, and the system discharge valve shall be open. The PLC control unit shall de-energize the system discharge valve's solenoid valve, causing the system discharge valve to slowly close. As the system discharge valve approaches its closed position, its micro switch shall trigger the PLC to de-energize the pump control valve, causing the control valve to slowly open and discharge water into the dump line. As the pump control valve nears its fully open position, its limit switch shall trigger the PLC to shut down the well pump unit. Should the water, upon falling back into well, create a vacuum in the pump discharge column, the pump vacuum release check valve shall open and break the vacuum. The PLC control unit shall be programmed to shut down the well pump unit should the shut procedure fail to complete the sequence within the programmed timeframe. PLC control unit to energize the system discharge

## 2.4 WELL PUMP CONTROL VALVE AND APPURTENANCES:

A. The well pump control valve shall conform in all respects with the latest revised version of AWWA C530.

### B. MAIN VALVE:

The valve shall be hydraulically operated, single diaphragm-actuated, globe pattern. A resilient synthetic rubber disc shall have a rectangular cross-section and shall be retained on three and one-half sides to assure proper gripping under extreme hydraulic conditions. The stainless steel valve stem shall be guided by three bearings located in the cover, the intermediate body, and the valve seat. The main valve shall consist of two distinct operating chambers that are detachable and completely independent of the flow through the main valve body.

### C. MAIN VALVE BODY:

The main valve body shall consist of four components: the body with seat installed, the intermediate body with bearing installed, the cover with bearings installed, and the diaphragm assembly. The valve body, power unit body and cover shall be of ductile iron material. The seat and cover bearing shall be of stainless steel construction. No fabrication or welding shall be used in the manufacturing process. The valve interior shall be coated with a NSF 61 and FDA approved epoxy resin.

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The diaphragm assembly shall be the only moving part and shall form a seal between the two operating chambers. Packing glands and/or stuffing boxes are not permitted. There shall be no pistons operating the main valve or pilot controls.

The valve shall contain a resilient, Buna-N rubber disc, with a rectangular cross-section contained on three and one-half sides by a disc retainer and forming a tight seal against a single removable seat insert. No O-ring type discs (circular, square, or quad-type) shall be permitted as the seating surface.

The stainless steel disc guide shall be of the contoured type to permit smooth transition of flow and shall hold the disc firmly in place. The disc retainer shall be of cast iron construction and of a sturdy one-piece design capable of withstanding line shocks due to abnormal pump stoppage. It must have straight edge sides. No hourglass-shaped disc retainers shall be permitted and no V-type disc guides shall be used.

The diaphragm assembly containing an upper and lower stem constructed of non-magnetic stainless steel of sufficient diameter to withstand high hydraulic pressures shall be fully guided through its complete stroke by a removable bearing in the valve cover, a removable bearing in the intermediate body, and an integral bearing in the valve seat. The valve shall be capable of modulating between a fully open and tightly closed position unless a static condition or pressure reversal occurs, in which case the valve shall close to prevent reverse flow regardless of the diaphragm position. The upper stem shall be drilled and tapped in the cover end to receive and affix such accessories as may be deemed necessary.

The flexible, non-wicking, FDA approved diaphragm shall consist of nylon fabric bonded with Buna-N rubber compatible with the operating fluid. The center hole for the main valve stem must be sealed by the vulcanized process or a rubber grommet sealing the center stem hole from the operating pressure. The diaphragm must withstand a Mullins Burst Test of a minimum of 600 psi per layer of nylon fabric and shall be cycle tested 100,000 times to insure longevity. The diaphragm shall be fully supported in the valve body and cover by machined surfaces, which support no less than one-half of the total surface area of the diaphragm in the either the fully open or fully closed position.

The main valve seat, the power unit body and the stem bearing in the valve cover shall be removable. The cover bearing and seat shall be threaded into the cover and body. To insure proper alignment of the valve stem, the valve body and cover shall be machined with a locating lip. No "pinned" covers to the valve body shall be permitted. All valve cover bolts, studs and nuts shall be of 316 stainless steel material. All necessary repairs and/or modifications other than replacement of the main valve body shall be possible without removing the valve from the pipeline.

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D. PILOT CONTROL SYSTEM:

The valve operation shall be controlled automatically by an externally mounted, four-way solenoid-operated pilot. The solenoid shall be designed to operate on AC or DC current and have a manual operator installed. The valve shall be normally open. When the solenoid valve energizes, the control valve shall slowly close. When the solenoid valve de-energizes, the control valve shall slowly open.

Opening and closing speed controls, shut off valves, shuttle valve, and strainers are to be provided by the Manufacturer.

E. LIMIT SWITCH:

An adjustable limit switch assembly shall be mounted on the main valve connected to the main valve stem. The limit switch shall be adjustable over the entire valve travel. The limit switch mounting bracket shall be of 316 stainless steel material, and if available, the limit switch shall be epoxy coated. The limit switch shall be Model X105LOW or approved equal.

F. The installing contractor shall install the valve per manufacturer's instructions, and shall have nearby plant facilities and equipment to immediately repair the valve units.

G. The pump control valve shall be ductile iron with 300 lb flanged ends and 400 psi pressure class body. Provide Cla-Val Model 61-02 with Cla-Val 100-02 Powertool Valve main body, or approved equal.

2.5 WELL SYSTEM DISCHARGE VALVE AND APPURTENANCES:

A. The well pump control valve shall conform in all respects with the latest revised version of AWWA C530.

B. MAIN VALVE:

The valve shall be hydraulically operated, single diaphragm-actuated, globe pattern with a built-in drop check feature to prevent return flow. A resilient synthetic rubber disc shall have a rectangular cross-section and shall be retained on three and one-half sides to assure proper gripping under extreme hydraulic conditions. The stainless steel valve stem shall be guided by two bearings located in the cover and the intermediate body. The main valve shall consist of two distinct operating chambers that are detachable and completely independent of the flow through the main valve body.

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C. MAIN VALVE BODY:

The main valve body shall consist of four components: the body with seat installed, the power unit body with center bearing, the cover with bearings installed, and the diaphragm assembly. The valve body, power unit body and cover shall be of ductile iron material. The seat and cover bearing shall be of stainless steel construction. No fabrication or welding shall be used in the manufacturing process. The valve interior shall be coated with a NSF 61 and FDA approved epoxy resin. The diaphragm assembly shall be the only moving part and shall form a seal between the cover chamber and intermediate chamber. Packing glands and/or stuffing boxes are not permitted. There shall be no pistons operating the main valve or pilot controls.

The valve shall contain a resilient, Buna-N rubber disc, with a rectangular cross-section contained on three and one-half sides by a disc retainer and forming a tight seal against a single removable seat. No O-ring type discs (circular, square, or quad-type) shall be permitted as the seating surface.

The stainless steel disc guide shall be of the contoured type to permit smooth transition of flow and shall hold the disc firmly in place. The disc retainer shall be of cast iron construction and of a sturdy one-piece design capable of withstanding line shocks due to abnormal pump stoppage. It must have straight edge sides. No hourglass-shaped disc retainers shall be permitted and no V-type disc guides shall be used.

The diaphragm assembly containing a non-magnetic stainless steel stem of sufficient diameter to withstand high hydraulic pressures shall be fully guided through its complete stroke by removable bearings in the valve cover and the intermediate body. The valve shall be capable of modulating between a fully open and tightly closed position unless a static condition or pressure reversal occurs, in which case the valve shall close to prevent reverse flow regardless of the diaphragm position. When the valve checks closed, the valve upper stem shall return to the closed position. The upper stem shall be drilled and tapped in the cover end to receive and affix such accessories as may be deemed necessary.

The flexible, non-wicking, FDA approved diaphragm shall consist of nylon fabric bonded with Buna-N rubber compatible with the operating fluid. The center hole for the main valve stem must be sealed by the vulcanized process or a rubber grommet sealing the center stem hole from the operating pressure. The diaphragm must withstand a Mullins Burst Test of a minimum of 600 psi per layer of nylon fabric and shall be cycle tested 100,000 times to insure longevity. The diaphragm shall be fully supported in the valve body and cover by machined surfaces, which support no less than one-half of the total surface area of the diaphragm in the either the fully open or fully closed position.

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The main valve seat, the power unit body and the stem bearing in the valve cover shall be removable. The valve seat shall be retained by flat head machine screws for ease of maintenance. To insure proper alignment of the valve stem, the valve body and cover shall be machined with a locating lip. No "pinned" covers to the valve body shall be permitted. All valve cover bolts, studs and nuts shall be of 316 stainless steel material. All necessary repairs and/or modifications other than replacement of the main valve body shall be possible without removing the valve from the pipeline.

D. PILOT CONTROL SYSTEM:

The valve operation shall be controlled automatically by an externally mounted, four-way solenoid-operated pilot. The solenoid shall be designed to operate on AC or DC current and have a manual operator installed. The valve shall be normally closed. When the solenoid valve energizes, the system discharge valve shall slowly open. When the solenoid valve de-energizes, the system discharge valve shall slowly close.

Opening and closing speed controls, shut off valves, shuttle valve, and strainers are to be provided by the Manufacturer.

E. LIMIT SWITCH:

An adjustable dual stem-mounted microswitch limit switch assembly shall be provided with the valve. One switch shall be actuated by opening the valve, and the other shall be actuated by closing the valve. The microswitch shall be adjustable over the entire valve travel. The microswitch mounting bracket shall be of 316 stainless steel material, and if available, the microswitch shall be epoxy coated. The dual microswitch shall be Model X105L2W Limit Switch Assembly or approved equal. Where possible, provide epoxy coated microswitches.

- F. The check feature shall close off against any return flow. When the check feature activates, the valve upper stem shall return to the closed position.
- G. The solenoid valve shall be interlocked with the pump start-up sequence, via the system valve microswitches. The pump shall not start without the system discharge valve's closed limit switch actuated.
- H. The installing contractor shall install the valve per manufacturer's instructions, and shall have nearby plant facilities and equipment to immediately repair the valve units.
- I. The pump control valve shall be ductile iron with 300 lb flanged ends and 400 psi pressure class body. Provide Cla-Val Model 60-BY with Cla-Val 100-04 Powercheck Valve main body, or approved equal.

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## 2.6 NRS GATE VALVE:

- A. Valve shall conform to the latest revision of AWWA Standard C515 covering resilient seated gate valves for water supply service.
- B. Valve shall have ductile iron body, bonnet, and O-ring plate, and the wedge shall be totally encapsulated with rubber. The sealing rubber shall be permanently bonded to the wedge per ASTM D429.
- C. Valve shall be supplied with O-ring seals at all pressure retaining joints. No flat gaskets shall be allowed.
- D. Stems shall be cast copper alloy with integral collars in full compliance of AWWA. All stems shall operate with copper alloy stem nuts independent of wedge and of stem. Stems shall have two O-rings located above thrust collar and on O-ring below. Stem O-rings shall be replaceable with valve fully opened and subjected to full pressure. Stem shall also have two low torque thrust bearings above and below stem collar to reduce friction during operation.
- E. The valve shall be a non-rising (NRS) stem, opening by turning left or right, and provided with a hand wheel with the word "Open" and an arrow to indicate direction to open.
- F. Waterway shall be smooth, unobstructed and free of all pockets, cavities and depressions in the seat area.
- G. The body, bonnet, and O-ring plate shall be fusion bonded epoxy coated both interior and exterior on body and bonnet. Epoxy shall be applied in accordance with AWWA C550 and be NSF 61 Certified.
- H. Provide Clow Valve Co. Resilient Wedge Gate Valve, Model 2638 or approved equal.

## 2.7 PUMP VACUUM RELEASE CHECK VALVE:

The pump vacuum release check valve shall be a flanged, soft-seated, center-guided vacuum breaker/check valve. The valve shall be provided with a resilient seat to provide "bubble-tight" sealing, and open in response to 0.25 psi vacuum. The valve body shall be semi-steel or cast iron with bronze bushing center guides. Stainless steel ASTM A351 Grade CF8M trim. Internal and external non-stick fusion bonded epoxy coating. Valmatic 1854VB (250 class), Combination Pump Valve, APCO, Metraflex or approved equal.

## 2.8 PRE/POST LUBE LINE SOLENOID VALVE:

- A. Combination pressure reducing and solenoid shutoff valve, which automatically reduces higher inlet pressure to steady lower downstream pressure.

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B. MAIN VALVE:

The valve shall be hydraulically operated, single diaphragm-actuated, globe pattern. Valve shall consist of three major components:

1. Body with sear installed
2. Cover with bearings installed
3. Diaphragm assembly

The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure. Packing glands and/or stuffing boxes are not permitted and there shall be no piston operating main valve or pilot controls.

C. MAIN VALVE BODY:

No separate chambers shall be allowed between the main valve cover and body. Valve body and cover shall be of cast material. Ductile Iron is standard, other materials shall be available. No fabrication or welding shall be used in the manufacturing process.

The valve shall contain a resilient, synthetic rubber disc, with a rectangular cross-section contained on three and one-half sides by a disc retainer and forming a tight seal against a single removable seat insert. No O-ring type discs (circular, square, or quad type) shall be permitted as the seating surface. The disc guide shall be of the contoured type to permit smooth transition of flow and shall hold the disc firmly in place. The disc retainer shall be of a sturdy one-piece design capable of withstanding opening and closing shocks. It must have straight edge sides and a radius at the top edge to prevent excessive diaphragm wear as the diaphragm flexes across this surface. No hourglass-shaped disc retainers shall be permitted and no V-type or slotted type disc guides shall be used.

The diaphragm assembly containing a non-magnetic 303 stainless steel stem of sufficient diameter to withstand high hydraulic pressures shall be fully guided at both ends by a bearing in the valve cover and an integral bearing in the valve seat. The seat shall be a solid, one-piece design and shall have a minimum of a five-degree taper on the seating surface for a positive, drip-tight shut off.

No center guides shall be permitted. The stem shall be drilled and tapped in the cover end to receive and affix such accessories as may be deemed necessary. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure.

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The flexible, non-wicking, FDA approved diaphragm shall consist of nylon fabric bonded with synthetic rubber compatible with the operating fluid. The center hole for the main valve stem must be sealed by the vulcanized process or a rubber grommet sealing the center stem hole from the operating pressure. The diaphragm must withstand a Mullins Burst Test of a minimum of 600 psi per layer of nylon fabric and shall be cycle tested 100,000 times to insure longevity. The diaphragm shall not be used as the seating surface. The diaphragm shall be fully supported in the valve body and cover by machined surfaces which support no less than one-half of the total surface area of the diaphragm in either the fully opened or fully closed position.

The main valve seat and the stem bearing in the valve cover shall be removable. The cover bearing and seat in 6" and smaller size valves shall be threaded into the cover and body. The valve seat in 8" and larger size valves shall be retained by flat head machine screws for ease of maintenance. The lower bearing of the valve stem shall be contained concentrically within the seat and shall be exposed to the flow on all sides to avoid deposits. To insure proper alignment of the valve stem, the valve body and cover shall be machined with a locating lip. No "pinned" covers to the valve body shall be permitted. Cover bearing, disc retainer, and seat shall be made of the same replacement of the main valve body shall be possible without removing the valve from the pipeline. Packing glands and/or stuffing boxes shall not be permitted and components including cast material shall be of North American manufacture.

The valve manufacturer shall warrant the valve to be free of defects in material and workmanship for a period of three years accordance with all applicable instructions. Electrical components shall have a one year warranty.

**D. PILOT CONTROL SYSTEM:**

The pressure reducing pilot control shall be a direct-acting, adjustable, spring-loaded, normally open, diaphragm valve designed to permit flow when controlled pressure is less than the spring setting. The pilot control is held open by the force of the compression on the spring above the diaphragm and it closes when the delivery pressure acting on the underside of the diaphragm exceeds the spring setting. The pilot control system shall include a fixed orifice. No variable orifices shall be permitted. The pilot system shall include an opening speed control on all valves.

The pilot control shall have a second downstream sensing port which can be utilized to install a pressure gauge.

The valve shall include a 3-way Nema IV Solenoid to intercept the pressure reducing control to close/open the main valve. The solenoid shall have a warranty of 1 year.

- E.** The valve manufacturer shall provide a computerized cavitation chart which show flow rate, differential pressure, percentage of valve opening, Cv factor, system velocity, and if there will be cavitation damage.

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- F. Upstream pressure is estimated to be 68psi. Set downstream pressure shall be 20psi. Contractor shall verify existing upstream pressure prior to ordering of valve.
- G. Provide Cla-Val Model 93-01 with threaded ends or approved equal.

2.9 SILENT CHECK VALVE:

- A. Globe style silent check valve.
- B. Valve shall incorporate a center guided, spring loaded disc and have a short linear stroke that generates a flow area equal to the nominal valve size.
- C. All components shall be field replaceable without the need of special tools. Valve shall be provided with a replaceable guide bushing held in position by the spring. The spring shall be designed to withstand 100,000 cycles without failure and provide cracking pressure of 0.5 psi.
- D. Globe disc shall be concave to the flow direction providing for disc stabilization, maximum strength, and minimum flow velocity to open valve.
- E. Valve disc and seat shall have seating surface finish of 16 micro-inches or better to ensure positive seating at all pressures. Leakage rate shall not exceed the allowable rate for metal seated valves allowed by AWWA C508 and MSS SP-125 or 1 fl. oz. per hour per inch of nominal size.
- F. Valve body shall be constructed of ASTM A126 Class B cast iron for Class 125 and Class 250 Valves.
- G. Seat and disc shall be ASTM B584 copper alloy C87600 lead-free bronze.
- H. Compression spring shall be ASTM A313 Type 316 stainless steel with ground ends.
- I. Provide Valve with a resilient seal on the seat to provide zero leakage at both high and low pressures without overloading or damaging the seal. The seal shall provide both a metal-to-metal and a metal-to-resilient seal.
- J. Valve shall be certified to NSF 61 and certified to be Lead-Free in accordance with NSF 372. Valve interiors and exteriors shall be coated with an NSF 61 certified fusion bonded epoxy in accordance with AWWA C550.
- K. Provide Val-matic Silent Check Valve, Globe Style, Series 1800 or approved equal.

2.10 FLAP VALVE:

- A. Circular port design flap valve with offset single pivoted hinge. Valve shall be of the

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iron body bronze mounted type and furnished with flanged end.

- B. Assembly shall consist of three parts: flap gate, body, and hinge pin. Flap gate and body shall be cast iron conforming to ASTM specifications A-126 Class B. Seats and hinge pin shall be bronze. Flap gate seal ring shall be rolled into a dovetailed groove under pressure to make one inseparable unit. The body seat ring shall be threaded and screwed into place in the body. Both gate and body seat ring faces shall be machined to a smooth finish.
- C. Valve shall be constructed with a 10 degree offset from vertical to ensure positive closure.
- D. Flange shall be drilled using ANSI 125 lb template.
- E. Provide Clow Valve Flap Valve Figure No. F-3012-T or approved equal. Flap valve not required to be NSF 61 certified.

### PART 3 - EXECUTION

(NOT USED)

END OF SECTION

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## SECTION 33 11 45

### WELL LEVEL TRANSMITTER, INDICATOR AND APPURTENANT EQUIPMENT

#### PART 1 – GENERAL

1.1 This section of the specifications covers the furnishings and installing of a well level indicator and appurtenances.

A. Well level indicator:

1. Number required: One (1)
2. Location: Deepwell gauge board

#### PART 2 – PRODUCTS

##### 2.1 WELL WATER TRANSMITTER:

- A. The instrument shall be a Foxboro Model 841G, ABB 264 HS, Yokogawa EJA 530A or approved equal. The instrument shall transmit a 4 to 20 milliamp DC signal proportional to the pressure. The instrument shall include a LCD indicator for programming and calibration.
- B. Power supply for the instrument shall be 120-volt, 60 Hertz, single phase power.

##### 2.2 WELL WATER INDICATOR:

- A. The well level indicator shall be furnished and installed in the gauge board as shown on the plans, and shall be a Red Lion Controls Model PAXP, Precision Digital Model PD 690 or approved equal.
- B. The indicator with 1/2-inch high, 4-1/2 digit display shall operate on 120 vac power and contain the 24-volt power supply for the 4 to 20 mA Signal transmitter. The instrument shall provide a continuous display of the water level elevation in the well in feet. The 4 to 20 mA signal shall correspond to (-) 15 to 35 feet of water on the indicator. A separate isolated 4 to 20 mA output signal shall also be provided.
- C. The instrument shall be furnished with two (2) SPST contacts to stop pumps on adjustable decreasing measurements. A contact shall also be provided for low level alarm. Set points shall be adjusted over the entire range of the indicator. Set points and calibration shall be possible from the front of the instrument without disassembly.

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2.3 PRESSURE REGULATOR:

- A. In connection with the liquid level recorder, a pressure regulating device shall be installed in the air supply line to the recorder. It shall be so designed that it will maintain 3 pounds differential between the inlet and outlet line by means of needed valve for regulating the flow rate and shall have a flow rate indicator.
- B. Each device shall have an air flow rate of 0 to 2.5 SCFH.
- C. The Contactor shall supply Cono-Controls Purge Assembly, type DH-21, Conoflow Corporation, Philadelphia; Fischer & Porter Model 10A3135N-53RB2110 Assembly; Brooks Model 13408800; or approved equal.

2.4 AIR LINES:

- A. Outside of well: The new air line installed underground between the well and the gauge board shall be 1/4-inch soft copper water tubing, type L. Each line shall be installed in a 2-inch PVC, schedule 80, conduit a minimum of 12 inches below the ground surface.

PART 3 - EXECUTION

(NOT USED)

END OF SECTION

Well Level Transmitter, Indicator and Appurtenant Equipment

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## SECTION 33 11 47

### AIR COMPRESSOR SYSTEM

#### PART 1 – GENERAL

##### 1.1 GENERAL DESCRIPTION:

This section of the specifications covers the furnishings and installing of the air compressor, air storage tank and appurtenant equipment.

#### PART 2 – PRODUCTS

##### 2.1 AIR COMPRESSOR AND AIR STORAGE TANK

- A. Number Required: One (1)
- B. Location: As indicated on plans
- C. Air compressor shall be vertical, tank mounted, factory-assembled unit. Compressor shall be a belt-driven, oil lubricated, reciprocating unit designed for an operating pressure in the range of 80-100 psi. Motor shall be a 1 HP, 460 volt, three phase, 60 Hertz unit with automatic reset thermal overload protection and standard power cord and plug.
- D. Assembly shall be complete with motor starter, belt guard, automatic pressure switch, pressure gauge, safety valve, drain cock, shut-off valve and a flexible coupling. Provide combination type starter with circuit breaker.
- E. Air receiver shall be a vertical, welded steel tank with mounting feet conforming to ASME code for Un-fired Pressure Vessels. Receiver shall be rated for 175 psi duty and shall bear an ASME stamp. Receiver capacity shall be 30 gallons. The entire assembly shall be thoroughly cleaned of rust and scale, have all sharp edges and corners ground smooth, and shall receive a shop coat of manufacturer's standard metal primer.
- F. Contractor shall provide an oil separator for the air compressor system. Oil Separator shall be a high efficiency oil removal filtration filter with particle removal down to 0.01 micron inclusive of water and oil aerosols. Provide maximum remaining oil aerosol content of 0.01 mg/m<sup>3</sup> @ 70°C. Provide Ingersoll-Rand FA30I with Grade H filter or approved equal.
- G. Provide Champion Commandair Model 30BVAS10V, Ingersoll-Rand, Quincy, Kellog-American, or approved equal. Complete detailed manufacturer's data on the assembly shall be submitted to and approved by the DLNR before order is placed.

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PART 3 - EXECUTION

(NOT USED)

END OF SECTION

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## SECTION 33 11 49

### MISCELLANEOUS COPPER AND BRASS PIPING

#### PART 1 – GENERAL

##### 1.1 GENERAL DESCRIPTION:

This section of the specifications includes the furnishing and installation of the miscellaneous copper and brass piping for gauge board, pressure detectors, instrumentation and diaphragm operated valves.

#### PART 2 – PRODUCTS

##### 2.1 MATERIALS:

###### A. COPPER TUBING

1. Copper tubing shall be Type K, confirming to ASTM B-88.
2. Copper fittings shall be ASME B16.18 cast copper or ASME B16.22 wrought copper with lead free solder joints.

###### B. BRASS PIPE

1. Brass pipe shall be red brass, regular strength.
2. Fittings shall be standard weight cast brass threaded fittings, rough finish.

###### C. BALL VALVE

1. Lead-free, NSF 61-G & 372 certified.
2. Bronze body, full port, blowout-proof stem, RPTFE seats, stuffing box ring, adjustable packing gland, and plated brass ball.
3. 600 psi non-shock cold working pressure, 150 psi steam working pressure.
4. Stainless steel level and nut option.
5. Provide Apollo Lead-Free 70LF Series ball valve or approved equal.

###### D. Pipe straps for tubing shall be of solid alloy copper, Grinnel CT-124 or approved equal.

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PART 3 - EXECUTION

(NOT USED)

END OF SECTION

Miscellaneous Copper and Brass Piping  
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