

**GUAM WATERWORKS AUTHORITY** 

Gloria B. Nelson Public Service Building • 688 Route 15, Mangilao, Guam 96913 • Tel. (671) 300-6036

Invitation To Bid:	IFB-01-ENG-2019 Santa Rosa, Santa Rita, and Sinifa Reservoir Replacement GWA Project No. W14-007-BND
Addendum No.:	04
Date:	April 25, 2019

**All Potential Bidders:** 

This addendum is issued to modify the previously issued bid documents and/or given for informational purposes, and is hereby made a part of the bid documents. Failure to acknowledge receipt of this addendum shall be grounds for the bidder's disqualification and rejection of the bidder's proposal.

- 1. Draft Agreement and Bid Form Revision 2 shall replace previous version(s) in its entirety.
- 2. Plans and Specifications Revision 2 as listed shall replace previous version(s) in its entirety.
- 3. Response No. 3 to bidders' inquiries are attached to this addendum.

Bidders are also notified to visit GWA website: <u>www.guamwaterworks.org</u> to ensure that all addenda to the bid, answers to questions, and reminders are communicated to all bidders throughout the solicitation process.

MON

MIGUEL C. BORDÁLLO, P.E. General Manager

Attachments: Response No. 3 to RFI Revised Bid Form and Agreement Revised Drawings and Specifications

MCB; gb

GUAM WATERWORKS AUTHORITY

Northern and Southern Guam Reservoir Replacement GWA Project No. W14-007-BND IFB-01-ENG-2019 GWA RFI Response No. 3 to Contractor Inquiries

informational purposes and to the extent the responses below modify the bid documents, please treat them as an amendment to the Bid. The This Addendum and/or Response to Request for Information (RFI) is issued to modify the previously issued bid documents and /or given for following responses are in response to RFIs received.

	REFERENCE	QUESTION/INQUIRY AS SUBMITTED:	GWA RESPONSE:	
	Questions from	April 11, 2019		
	Sheets P100, P101, M100 and M101	Shows pressure gauges, transmitters and switches designated as PI, PIT, PSL, PSH at the Inlet Vaults, Outlet Vaults, and Pump Station (Santa Rosa). However we cannot locate the corresponding details for these instrumentation devices on Sheet 1300. Can a schedule be provided with corresponding details to the required pressure gauges, transmitters, and switches?	Pressure gauge (PI) detail corresponds to Detail 2 / I-300. Pressure transmitter (PIT) detail corresponds to Detail 3 / I-300. Per P-100, the pressure switch (PSL, PSH) is mounted on the same apparatus as a pressure gauge (PI) as shown in Detail 1 / I-300.	
5	Sheets M002	Provides the Meter Schedule requiring Electro-Magnetic Meters. However we cannot locate the specification section for the required Electro-Magnetic Meters including manufacturers, class ratings, coatings, flow rates, etc. Please provide the specification for the electro-magnetic meters.	Refer to Section 407910-2.6 for electromagnetic flow meter (flow transmitter) specification.	
e e e e e e e e e e e e e e e e e e e	Section 00410, Bid Schedule, Table A, includes Bid Item 7.4 – Electrical	However we cannot locate any electrical drawings for the DOD Intertie work. Please confirm if electrical work is required for the DOD Intertie and provide drawings if needed.	See Sheet I701, which is incorrectly located following Sheet I501. Move sheet to follow M702.	
4	Section 400501	Part 2.1.E, states, "Pipes above ground or in structures shall be field- coated." However we cannot locate the above grade pipe coating system schedule in Section 099000 –	Specification Section 099000, 3.16 A, FM-16: Item Description shall be revised to read:	

		Painting & Coating, Part 3.16. Please provide the required coating system for above grade / exposed piping in the vaults and pump station. We would recommend the use	"Surfaces of indoor equipment and piping not submerged." Surface Preparation shall be
		of System No 8 (two part epoxy coating) located in Section 099000, Part 2.2.H.	revised to read: "Commercial Blast Cleaning SSPC-SP 6 for equipment and Near White Metal Blast Cleaning SSPC-SP 10 for piping"
Sectio	<b>د</b> «	Part 2.1. A.6 allows the use of either ductile iron AWWA C110 fittings or AWWA C153 compact fittings, cement mortar lined to AWWA C104 when part of ductile iron pipe system. Part 2.1.B indicates that fittings for use with C900 PVC Pipe (same application) must be AWWA C110 and must be Fusion epoxy lined and coated. Since the two piping materials carry the same media, we cannot see the reason for two separate fitting	Section 331113, 2.1 A. 6. C. 1) & 2) shall be replaced with "1) AWWA C116/A21.16, fusion- bonded epoxy". In Section 331113, 2.1 B. 1., after the words "AWWA C110", add the words: "or AWWA C153", and in the same paragraph,
	2	standards and two separate lining standards. Please confirm AWWA C153 compact fittings are acceptable whether the piping system is AWWA C900 PVC or ductile iron. Please also confirm that cement lining is the suitable lining material for all piping under Section 331113.	change the second use of the word "exterior" to "interior".
Ques	tions from	April 12, 2019	
Speci sectic	fications, on 033140	Paragraph 2.2.C references a zinc coating in the chart. Please confirm if the high strength threadbar may be coated with unocal soluble oil 10, Rustban and then epoxy grouted once tensioning is complete, in lieu of zinc coating.	Disregard reference to zinc coating in Para 2.2.C of the specs. Use coated vertical threadbars as indicated in the drawings.
Speci	fications, on 033140	Paragraph 3.14.D.2 states an allowable leakage of 0.0125%. On a 45' high tank this equates to approximately a 16th of an inch. This can be challenging to measure and track. Please confirm if AWWA D110 guidelines may be followed which state an allowable leakage of 1/20th of one percent (0.05%). This is similar to the requirements for the Central Guam Reservoirs, Barrigada Tanks, spec section 01650-3.3-C-2-a.	Paragraph 3.14 D. 2. shall be revised to read "is equal to or less than 0.050 percent"
Santa Draw	Rita ing S102	Shows hook bars coming out of the piles which will interfere with the column reinforcing. Please confirm the vertical bars in the piles under the columns can have 180 hooks on the ends keeping them within the core when beneath the columns.	For the piles under columns, it is OK to extend the pile reinforcing inside the mat as shown, but without any hooks. Reinforcement for other piles shall remain as indicated.
Sta. R Rosa Reser Sheet	iita, Sta. and Sinifa voir, c C012	The road width is 12' minimum. Is the corrugated steel panels 2-8'x10' or 2-8'x6'?	Detail is suggestion only. Contractor is responsible for final design and/or modification to suggested detail shown on C012 to meet GEPA Soil Erosion and Sediment Control Regulations.
٦			

2 of 3

See Note 6 on SS-010. Diameter for Overflow Discharge MH's shall be 5'.		
In Note #5, all aspects of standard detail SS-010 on sheet 321 shall apply to manholes constructed in this project. The manhole diameter in C322 is 5' but the manhole diameter in the standard detail on sheet C321 is 4? Which is correct?		
Sta. Rita, Sta. Rosa and Sinifa Reservoir, Sheet C322		
10		1

Bidders are also notified to visit GWA website: www.guamwaterworks.org to ensure that addenda to the bid, answers to questions, and reminders are communicated to all bidders throughout the solicitation process.

MIGUEL C. BORDALLO, P.E. General Manager

MCB;gb

# TABLE OF CONTENTS

Article 1 - BID RECIPIENT	2
Article 2 - BIDDER'S ACKNOWLEDGMENTS	2
Article 3 - BIDDER'S REPRESENTATIONS	2
Article 4 - BIDDER'S CERTIFICATIONS	3
Article 5 - BASIS OF BID	4
Article 6 - TIME OF COMPLETION	19
Article 7 - ATTACHMENTS TO THIS BID	19
Article 8 - DEFINED TERMS	19
Article 9 - BID SUBMITTAL	19

#### **BID FORM**

#### **BID RECIPIENT**

This Bid is submitted to:

<u>Guam Waterworks Authority</u> <u>Engineering Division, Room 202</u> <u>Gloria B. Nelson Public Service Building</u> <u>688 Route 15</u> <u>Mangilao, Guam 96913</u>

The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into a Contract with Buyer in the form included in the Bidding Documents to furnish the Goods and Special Services as specified or indicated in the Bidding Documents, for the prices and within the times indicated in this Bid, and in accordance with the other terms and conditions of the Bidding Documents.

#### **BIDDER'S ACKNOWLEDGMENTS**

Bidder accepts all of the terms and conditions of the Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for 60 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Buyer.

#### **BIDDER'S REPRESENTATIONS**

In submitting this Bid, Bidder represents that:

Bidder has examined and carefully studied the Bidding Documents, the related data identified in the Bidding Documents, and the following Addenda, receipt of which is hereby acknowledged:

Addendum No.	Addendum Date

- Bidder has visited the Point of Destination and site where the Goods are to be installed or Special Services will be provided and become familiar with and is satisfied as to the <u>observable</u> local conditions that may affect cost, progress, or the furnishing of Goods and Special Services, if required to do so by the Bidding Documents, or if, in Bidder's judgment, any local condition may affect cost, progress, or the furnishing of Goods and Special Services.
- Bidder is familiar with and is satisfied as to all Laws and Regulations in effect as of the date of the Bid that may affect cost, progress, and the furnishing of Goods and Special Services.

- Bidder has carefully studied, considered, and correlated the information known to Bidder; information commonly known to sellers of similar goods doing business in the locality of the Point of Destination and the site where the Goods will be installed or where Special Services will be provided; information and observations obtained from Bidder's visits, if any, to the Point of Destination and the site where the Goods will be installed or Special Services will be provided; and any reports and drawings identified in the Bidding Documents regarding the Point of Destination and the site where the Goods will be installed or where Special Services will be provided; and any reports and drawings identified in the Bidding Documents regarding the Point of Destination and the site where the Goods will be installed or where Special Services will be provided, with respect to the effect of such information, observations, and documents on the cost, progress, and performance of Seller's obligations under the Bidding Documents.
- Bidder has given Engineer written notice of all conflicts, errors, ambiguities, and discrepancies that Bidder has discovered in the Bidding Documents, and the written resolution (if any) thereof by Engineer is acceptable to Bidder.
- The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for furnishing the Goods and Special Services for which this Bid is submitted.

#### **BIDDER'S CERTIFICATIONS**

Bidder certifies that:

- This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation;
- Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid;
- Bidder has not solicited or induced any individual or entity to refrain from bidding; and
- Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph 4.01.D:
  - 1. "corrupt practice" means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process;
  - 2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Buyer, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Buyer of the benefits of free and open competition;
  - 3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Buyer, a purpose of which is to establish bid prices at artificial, non-competitive levels; and
  - 4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process.

# **BASIS OF BID**

Bidder will furnish the Goods and Special Services in accordance with the Contract Documents for the following price(s):

# **BID SCHEDULE**

Interested Bidders must complete Table A, Table B, and Table C. All blanks in the tables must be filled out.

Definitions:

LS = lump sum

	TABLE A SANTA ROSA RESERVOIR BID SCHEDULE (BASE BID ITEMS NO. 1 – 6, ADDITIVE BID ITEMS 7, 8, <mark>9, 10 &amp; 11</mark> )					
ltem No.	Description	Quantity	Unit	Extended Amount		
1.	Mobilization, as specified in the Contract Documents. <u>Item 1 Breakdown:</u> 1.1 Move onto Site 1.2 Field Offices, fit out and utilities 1.3 Project Scheduling 1.4 Assessment of existing reservoir per SP C-4 1.5 Other mobilization items	1	LS	\$ \$ \$ \$ \$		
2.	Demolition of existing facilities, including the booster pump building and foundation, fuel system and containment, paving, chain link fences and gates, piping, and appurtenances, as shown and specified in the Contract Documents.	1	LS	\$		

	TABLE A SANTA ROSA RESERVOIR BID SCHEDULE					
	(BASE BID ITEMS NO. 1 – 6, ADDITIVE BID ITEMS 7, 8, <mark>9, 10 &amp; 11</mark> )					
ltem No.	Description	Quantity	Unit	Extended Amount		
3.	Construction of Santa Rosa Reservoir No. 2, including a 1.0 million gallon (MG) nominal capacity pre-stressed concrete tank, earthwork, yard piping, fences and gates, coatings, electrical, instrumentation and controls, site lighting, disinfection, testing, startup, and all appurtenant work, complete and operable, as shown and specified in the Contract Documents. <u>Item 3 Breakdown</u> 3.1 Earthwork 3.2 Tank Foundation 3.3 Tank Piping & Valving 3.4 Pre-stressed Concrete Tank 3.5 Tank Appurtenances 3.6 Tank Coating 3.7 Tank & Piping Disinfection 3.8 Testing & Startup 3.9 Electrical System 3.10 Instrumentation and Control 3.11 Yard Piping & Valving 3.12 Inlet Vault, Meter, Valves & Piping 3.13 Outlet Vault, Meter, Valves and Piping 3.14 Drain Vault, Valves and Piping 3.15 Check Valve Vault, Valves and Piping 3.16 Overflow Manhole, and Piping 3.17 Site Poles & Lighting 3.18 Fencing and Gates 3.19 All other appurtenant work			\$       \$		
	Subtotal	1	LS	\$		

	TABLE A SANTA ROSA RESERVOIR BID SCHEDULE				
	(BASE BID ITEMS NO. 1 – 6, AD	DITIVE BID	ITEMS 7, 8	3, <mark>9, 10 &amp; 11</mark> )	
ltem No.	Description	Quantity	Unit	Extended Amount	
4.	Site Grading and pavement including retaining walls, curbs, concrete gutters, headwalls, sidewalk, stormwater swales, stormwater infiltration basin and outlet structures, access road, and riprap.	1	LS	\$	
5.	Construction of Control/Pump Station Building, including pumps, hydro- pneumatic tank, electrical and controls, earthwork, and all appurtenant work, complete and operable as shown and specified in accordance with the Contract Documents. <u>Item 5 Breakdown</u> 5.1 Control/Pump Station Building 5.2 Pump System 5.3 Hydro-pneumatic Tank 5.4 Electrical 5.5 Controls 5.6 Piping and Valves 5.7 All other appurtenant work	1	LS	\$ \$	

	TABLE A SANTA ROSA RESERVOIR BID SCHEDULE (BASE BID ITEMS NO. 1 – 6, ADDITIVE BID ITEMS 7, 8, <mark>9, 10 &amp; 11</mark> )					
ltem No.	Description	Quantity	Unit	Extended Amount		
6.	Construction of Pressure Zone Realignment (PZR) Sites 1 through 6, including survey staking, potholing, trenching, pipe connections, piping and fittings, valves and valve boxes, backfill and paving, disinfection, testing, traffic control, and all appurtenant work, complete and operable, as shown and specified in accordance with the Contract Documents. <u>Item 6 Breakdown</u> 6.1 Site 1 6.2 Site 2 6.3 Site 3 6.4 Site 4 6.5 Site 5 6.6 Site 6	1	LS	\$ \$ \$ \$ \$ \$ \$ \$		

	TABLE A SANTA ROSA RESERVOIR BID SCHEDULE (BASE BID ITEMS NO. 1 – 6, ADDITIVE BID ITEMS 7, 8, <mark>9, 10 &amp; 11</mark> )				
ltem No.	Description	Quantity	Unit	Extended Amount	
7.	Additive Bid Item: Construction of Department of Defense (DoD) Inter-Tie, within the GWA property, including survey staking, potholing, excavation, trenching, concrete vaults, pipe connections, piping and fittings, operational valves, control valves and adjustments thereto, meter with remote readouts, instrumentation and conduit, backfill, grading and gravel surfacing, bollard, disinfection, testing, and all appurtenant work, complete and operable, as shown and specified in accordance with the Contract Documents. <u>Item 7 Breakdown</u> 7.1 Concrete Vaults 7.2 Piping and Valves 7.3 Instrumentation 7.4 Electrical 7.5 All other appurtenant work	1	LS	\$ \$ \$ \$ \$ \$	
8.	Additive Bid Item: Construction of Department of Defense (DoD) Inter-Tie, within the DoD property, including survey staking, potholing, excavation, trenching, pipe connections, piping and fittings, isolation valve, backfill, grading and reseeding, gate, disinfection, testing, and all appurtenant work, complete and operable, as shown and specified in accordance with the Contract Documents. <u>Item 8 Breakdown:</u> 8.1 Piping and Valves 8.2 All other appurtenant work	1	LS	\$ \$ \$	

	TABLE A SANTA ROSA RESERVOIR BID SCHEDULE (BASE BID ITEMS NO. 1 – 6, ADDITIVE BID ITEMS 7, 8, 9, 10 & 11)					
ltem No.	Description	Quantity	Unit	Extended Amount		
9.	Additive Bid Item: Construction of Route 1 12" Waterline, 4,042 L.F., including tie-ins, valves, fittings, pipe jumpers, ARV's, excavation, backfill, resurfacing, testing, disinfection, traffic control, and all appurtenant work, complete and operable, as shown and specified in accordance with the Contract Documents.	1	LS	\$		
10.	Additive Bid Item: Demolition and disposal of existing reservoir, including foundation and appurtenances thereto.	1	LS	\$		
11.	Additive Bid Item: Remove and dispose of reservoir foundation oiled sand (6" thick over 6" base course) as hazardous waste.	1	LS	\$		

# Table A Base Bid Subtotal

Table A Base Bid and Additive Bid Subtotal

\$\_\_\_\_\_

\$\_\_\_\_\_

	TABLE B SANTA RITA RESERVOIR BID SCHEDULE						
	(BASE BID ITEMS NO. 1 – 6, ADDITIVE BID ITEMS 7 & 8)						
ltem No.	Description	Quantity	Unit	Extended Amount			
1.	Mobilization, as specified in the Contract Documents. <u>Item 1 Breakdown:</u> 1.1 Move onto Site 1.2 Field Offices, fit out and utilities 1.3 Project Scheduling 1.4 Other mobilization items	1	LS	\$ \$ \$ \$			
2.	Repair Access Road, including removal of debris, grading, installation of two 12" water lines, installation of electrical ductbank, connections to existing water and electrical facilities at ends of repairs, testing, disinfection, and appurtenances, as shown and specified in the contract documents.	1	LS	\$			
3.	Demolition of existing facilities, including the steel reservoir, its foundation and appurtenances thereto, paving, electrical vaults, chain link fences and gates, piping, concrete vaults, concrete swales, concrete curbs, and appurtenances, as shown and specified in the Contract Documents.	1	LS	\$			

	TABLE B SANTA RITA RESERVOIR BID SCHEDULE					
	(BASE BID ITEMS NO. 1 –	6, ADDITIV	'E BID ITEN	1S 7 & 8)		
ltem No.	Description	Quantity	Unit	Extended Amount		
4.	Construction of Santa Rita Reservoir, including a 1.0 million gallon (MG) nominal capacity pre-stressed concrete tank on pile foundation, earthwork, yard piping, fences and gates, protective coating, electrical, instrumentation and controls, site lighting, disinfection, testing, startup, and all appurtenant work, complete and operable, as shown and specified in the Contract Documents. <u>Item 4 Breakdown</u> 4.1 Earthwork 4.2 Foundation Piles and Base 4.3 Tank Piping & Valving 4.4 Pre-stressed Concrete Tank 4.5 Tank Appurtenances 4.6 Tank Coating 4.7 Tank & Piping Disinfection 4.8 Testing & Startup 4.9 Electrical System 4.10 Instrumentation and Control 4.11 Yard Piping & Valving 4.12 Inlet Vault, Meter, Valves and piping 4.13 Outlet Vault, Meter, Valves and Piping 4.14 Overflow Manhole and Piping 4.15 Site Poles & Lighting 4.16 Fencing and Gates 4.17 All other appurtenant work			\$ \$		
	Subtotal	1	LS	\$		

	TABLE B SANTA RITA RESERVOIR BID SCHEDULE (BASE BID ITEMS NO. 1 – 6, ADDITIVE BID ITEMS 7 & 8)						
ltem No.	Description Quantity Unit Extended Amount						
5.	Site Grading and pavement including curbs, concrete gutters, sidewalks, stormwater swales, storm drainage inlets and piping, headwalls, riprap, and stormwater infiltration basins and outlet structures, access roads and fencing.	1	LS	\$			
6.	Construction of Control Building, complete and operable, as shown and specified in accordance with the Contract Documents.	1	LS	\$			

7.	Additive Bid Item: Construction of			
	Pressure Zone Realignment (PZR)			
	Sites 1 through 12, including survey			
	staking, demolition, potholing,			
	trenching, pipe connections, piping			
	and fittings, valves and vaults, backfill			
	and paving, disinfection, testing,			
	traffic control, and all appurtenant			
	work, complete and operable, as			
	shown and specified in accordance			
	with the Contract Documents.	1	LS	\$
	Item 7 Breakdown			
	7.1 Site 1			
	7.1a Concrete Vault			\$
	7.1b Pressure Reducing Valves			\$
	7.1c Connections/Piping/Fittings			\$
	7.1d Gate Valves			\$
	7.2 Site 2			
	7.2a Concrete Vault			\$
	7.2b Pressure Reducing Valves			\$
	7.2c Connections/Piping/Fittings			\$
	7.2d Gate Valves			\$
	7.3 Site 3			\$
	7.4 Site 4			
	7.4a Concrete Vault			\$
	7.4b Pressure Reducing Valves			\$
	7.4c Connections/Piping/Fittings			\$
	7.4d Gate Valves			\$
	7.5 Site 5			\$
	7.6 Site 6			\$
	7.7 Site 7			
	7.7a Concrete Vault			\$
	7.7b Pressure Reducing Valves			\$
	7.7c Connections/Piping/Fittings			\$
	7.7d Gate Valves			\$
	7.8 Site 8			
	7.8a Concrete Vault			\$
	7.80 Pressure Reducing Valves			>
	7.80 Connections/Piping/Fittings			>
				ې د
	7.9 Sile 9			ې د
	7.10 Sile 10 7.11 Site 11			ې د
	7.11 SILE 11 7.12 Site 12			
	7.12 SILE 12			ې

8.	Additive Bid Item: Remove and dispose of reservoir foundation oiled sand (4" thick over 6" base course with oil surfacing) as hazardous waste.	1	LS	\$
----	--	---	----	----

Table B Base Bid Subtotal

\$\_\_\_\_\_ \$\_\_\_\_\_

Table B Base Bid and Additive Bid Subtotal

TABLE C SINIFA RESERVOIR BID SCHEDULE					
	(BASE BID ITEMS NO. 1 –	5, ADDITIV	E BID ITEN	1S 6 & 7)	
ltem No.	Description	Quantity	Unit	Extended Amount	
1.	Mobilization, as specified in the Contract Documents. <u>Item 1 Breakdown:</u> 1.1 Move onto Site 1.2 Field Offices, fit out and utilities 1.3 Project Scheduling 1.4 Grant of Temporary Easement for Construction 1.5 Assessment of existing reservoir per SP C-4 1.6 Other mobilization items	1	LS	\$ \$ \$ \$ \$ \$ \$ \$ \$ \$	
2.	Demolition of existing facilities, including the pavement, electrical vaults, chain link fences and gates, piping, concrete vaults, concrete swales, concrete curbs, and appurtenances, as shown and specified in the Contract Documents.	1	LS	\$	
3.	Construction of Sinifa Reservoir, including a 1.0 million gallon (MG) nominal capacity pre-stressed concrete tank, earthwork, yard piping, fences and gates, coatings, electrical, instrumentation and controls, site lighting, disinfection, testing, startup, and all appurtenant work, complete and operable, as shown and specified in the Contract Documents. <u>Item 3 Breakdown</u> 3.1 Earthwork 3.2 Tank Foundation 3.3 Tank Piping & Valving 3.4 Pre-stressed Concrete Tank 3.5 Tank Appurtenances 3.6 Tank Coating 3.7 Tank & Piping Disinfection	1	LS	\$ \$	

TABLE C SINIFA RESERVOIR BID SCHEDULE									
	(BASE BID ITEMS NO. $1 - 5$ , ADDITIVE BID ITEMS 6 & 7)								
ltem No.	Description	Quantity	Unit	Extended Amount					
	<ul> <li>3.8 Testing &amp; Startup</li> <li>3.9 Electrical System</li> <li>3.10 Instrumentation and Control</li> <li>3.11 Yard Piping &amp; Valving</li> <li>3.12 Inlet Vault, Meter, Valves &amp;</li> <li>Piping</li> <li>3.13 Outlet Vault, Meter, Valves</li> <li>and Piping</li> <li>3.14 Drain Vault, Valves and Piping</li> <li>3.15 Check Valve Vault, Valves and</li> <li>Piping</li> <li>3.16 Overflow Manhole, and Piping</li> <li>3.17 Site Poles &amp; Lighting</li> <li>3.18 Fencing and Gates</li> <li>3.19 Fuel System Improvements</li> <li>3.20 All other appurtenant work</li> </ul>			\$ \$					
	Subtotal	1	LS	\$					
4.	Site Grading and pavement including retaining walls, curbs, off-site driveway, concrete gutters, headwalls, sidewalks, stormwater swales, storm drainage structures and piping, infiltration basins, riprap, and access roads.	1	LS	\$					
5.	Construction of Control Building, complete and operable, as shown and specified in accordance with the Contract Documents.	1	LS	\$					

TABLE C SINIFA RESERVOIR BID SCHEDULE							
	(BASE BID ITEMS NO. 1 – 5, ADDITIVE BID ITEMS 6 & 7)						
ltem No.	Description	Quantity	Unit		Extended Amount		
6.	Additive Bid Item: Demolition and disposal of existing reservoir, including foundation and appurtenances thereto.	1	LS	\$			
7.	Additive Bid Item: Remove and dispose of reservoir foundation oiled sand (6" thick over 6" base course) as hazardous waste.	1	LS	\$			
Table Table	C Base Bid Subtotal C Base Bid and Additive Bid Subtotal		\$ \$				
Table	A, B, and C Base Bid Total			\$			
Table	A, B, and C Base Bid and Additive Bid 1		\$				
ΤΟΤΑΙ	TOTAL BASE BID PRICE FOR THE BID SCHEDULE (Table A, B and C)						
	For the lump sum of:						

\$\_\_\_\_

(Price in Figures)

(Price in Words)

Bidder acknowledges that estimated quantities are not guaranteed, and are solely for the purpose of comparison of Bids, and final payment for all unit price Bid items will be based on actual quantities, determined as provided in the Contract Documents. Bidder also acknowledges that each unit price includes an amount considered by Bidder to be adequate to cover Bidder's overhead and profit for each separately identified item.

#### TIME OF COMPLETION

Bidder agrees that the furnishing of Goods and Special Services will conform to the schedule set forth in Article 5 of the Agreement.

Bidder accepts the provisions of the Agreement as to liquidated damages.

#### ATTACHMENTS TO THIS BID

The following documents are attached to and made a condition of this Bid:

Required Bid security in the form of \_\_\_\_\_\_.

List of Proposed Major Suppliers;

Required Bidder Qualification Statement with Supporting Data.

#### **DEFINED TERMS**

The terms used in this Bid with initial capital letters have the meanings stated in the Instructions to Bidders, the General Conditions, and the Supplementary Conditions.

#### **BID SUBMITTAL**

This Bid submitted by:

If Bidder is:

An Individual

Name (typed or printed): \_\_\_\_\_

By: \_\_\_\_\_

(Individual's signature)

Doing business as: \_\_\_\_\_

Business address: \_\_\_\_\_

Phone:	Facsimile:
--------	------------

E-mail address: \_\_\_\_\_

# <u>A Partnership</u>

Partnership Name:		(SEAL)
Bv:		
, (Signature of general partner - attach evid	ence of authority to sign)	
Name (typed or printed):		
Business address:		-
 Phone:	Facsimile:	
E-mail address:	-	
<u>A Corporation</u>		
Corporation Name:		
State of Incorporation:		_
Type (General Business, Professional, Service, other):		-
Bv:		
, (Signature - attach evidence of authority to	o sign)	
Name (typed or printed):		
Title:		
(CORPORATE SEAL	)	
(Signature of Corporate Secretary)		-
Business address:		-
 Phone:	Facsimile:	
E-mail address:	-	
A Limited Liability Company (LLC)		
LLC Name:		
State in which organized:		
Bv:		
, (Signature - attach evidence of authority to	o sign)	
Name (typed or printed):		
Title:		
Business address:		-
Phone:	Facsimile:	
E-mail address:	_	

|--|

First Joint Venturer Name:		(SEAL)
Ву:		
(Signature - attach evidence of	authority to sign)	
Name (typed or printed):		
Title:		
Business address:		
Phone:	Facsimile:	
E-mail address:		
Second Joint Venturer Name:		(SEAL)
Ву:		
(Signature - attach evidence of	authority to sign)	
Name (typed or printed):		
Title:		
Business address:		
Phone:	Facsimile:	
E-mail address:		
Phone and Facsimile Number, and Address	s for receipt of official communicatio	ns to Joint Venture:

(Each joint venturer must sign. The manner of signing for each individual, partnership, corporation, and limited liability company that is a party to the joint venture should be in the manner indicated above.)

# AGREEMENT BETWEEN OWNER AND CONTRACTOR FOR CONSTRUCTION CONTRACT (STIPULATED PRICE)

THIS AGREEMENT is by and between \_\_\_\_\_ ("Owner") and

("Contractor").

Owner and Contractor hereby agree as follows:

#### ARTICLE 1 – WORK

- 1.01 Contractor shall complete all Work as specified or indicated in the Contract Documents. The Base Bid Work is generally described as follows:
  - Santa Rosa reservoir site: demolition of existing facilities, including the existing pump 1. building, chain link fences and gates, fuel tank and containment pit, yard piping, and appurtenances and the construction of the Santa Rosa Water Reservoir No. 2, including one 1.0 million gallon (MG) nominal capacity pre-stressed concrete water tank, a new building housing a control room and booster pump station, earthwork, standby generator and fuel system, site work, piping, utility tie-in connections, protective coatings, flow meters, valves, concrete vaults, concrete retaining walls, concrete headwalls, roadways, fencing, electrical, instrumentation and controls, testing, startup, and appurtenant work, as shown and specified, complete and operable, in accordance with the Contract Documents. Off-site work includes installation of piping and valves at various locations, as indicated on the plans. In addition, the Work includes five additive bid items. The first two additive bid items comprise an intertie between the GWA water system and the Department of Defense (DoD) water system including connections, piping, metering, valves and vaults, as shown on the plans and as specified. The third additive bid item consists of installing approximately 4,042 linear feet of 12" waterline in Route 1, including connections, piping, valves, and fittings, as well as other piping and connections, as shown on the plans and as specified. The fourth additive bid item consists of demolition of the existing steel reservoir, including foundation and appurtenances thereto. The fifth additive bid item consists of removal and disposal of the reservoir foundation oiled sand as hazardous waste if it is so determined. The Work is located as indicated on the plans.
  - 2. Santa Rita reservoir site: demolition of existing facilities, including the existing reservoir, chain link fences and gates, yard piping, and appurtenances and the construction of the Santa Rita Water Reservoir, including one 1.0 million gallon (MG) nominal capacity pre-stressed concrete water tank supported by a pile foundation, a new building housing a control room, earthwork, access road and utility repairs and improvements, site work, piping, utility tie-in connections, protective coatings, flow meters, valves, concrete vaults, concrete headwalls, roadways, fencing, electrical, instrumentation and controls, testing, startup, and appurtenant work, as shown and specified, complete and operable, in accordance with the Contract Documents. In addition, the Work includes two additive bid items. The first additive bid item consists of installation of vaults, piping and valves at various locations, including PRSV stations,

as indicated on the plans and as specified. The second additive bid item consists of the removal and disposal of the reservoir foundation oiled sand as hazardous waste if it is so determined. The Work is located as indicated on the plans.

3. Sinifa reservoir site: demolition of existing facilities, including the existing reservoir, chain link fences and gates, yard piping, and appurtenances and the construction of the Sinifa Water Reservoir, including one 1.0 million gallon (MG) nominal capacity prestressed concrete water tank, a new building housing a control room, fueling system improvements for existing standby generator, earthwork, access road improvements, site work, reinforced concrete retaining walls, piping, utility tie-in connections, protective coatings, flow meters, valves, concrete vaults, concrete headwalls, roadways, fencing, electrical, instrumentation and controls, testing, startup, and appurtenant work, as shown and specified, complete and operable, in accordance with the Contract Documents. In addition, the Work includes two additive bid items. The first additive bid item consists of demolition and disposal of the existing reservoir, including foundation and appurtenances thereto. The second additive bid item consists of the removal and disposal of the reservoir foundation oiled sand as hazardous waste if it is so determined. The Work is located as indicated on the plans.

## **ARTICLE 2 – THE PROJECT**

2.01 The Project, of which the Work under the Contract Documents is a part, is generally described as follows: Santa Rosa, Santa Rita, and Sinifa Reservoir Replacement; GWA Project No. W14-007-BND.

## **ARTICLE 3 – ENGINEER**

- 3.01 The part of the Project that pertains to the Work has been designed by TG Engineers, LLC.
- 3.02 The Owner has retained GHD ("Engineer") to act as Owner's representative, assume all duties and responsibilities, and have the rights and authority assigned to Engineer in the Contract Documents in connection with the completion of the Work in accordance with the Contract Documents.

#### **ARTICLE 4 – CONTRACT TIMES**

- 4.01 *Time of the Essence* 
  - A. All time limits for Milestones, if any, Substantial Completion, and completion and readiness for final payment as stated in the Contract Documents are of the essence of the Contract.

#### 4.02 *Contract Times: Days*

A. The Work for the Santa Rosa Reservoir Replacement Base Bid will be substantially completed within <u>395</u> calendar days from Notice to Proceed issuance as provided in Paragraph 4.01 of the General Conditions, and completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions within <u>455</u> days after the date when the Contract Times commence to run.

The Work for the Santa Rita Reservoir Replacement Base Bid will be substantially completed within <u>425</u> calendar days from Notice to Proceed issuance as provided in Paragraph 4.01 of the General Conditions, and completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions within <u>485</u> days after the date when the Contract Times commence to run.

The Work for the Sinifa Reservoir Replacement Base Bid will be substantially completed within <u>365</u> calendar days from Notice to Proceed issuance as provided in Paragraph 4.01 of the General Conditions, and completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions within <u>425</u> days after the date when the Contract Times commence to run.

- B. Parts of the Work shall be substantially completed on or before the following Milestone(s):
  - 1. Milestone 1 [event & date/days] NA
  - 2. Milestone 2 [event & date/days] NA
  - 3. Milestone 3 [event & date/days] NA

## 4.03 *Liquidated Damages*

- A. Contractor and Owner recognize that time is of the essence as stated in Paragraph 4.01 above and that Owner will suffer financial and other losses if the Work is not completed and Milestones not achieved within the times specified in Paragraph 4.02 above, plus any extensions thereof allowed in accordance with the Contract. The parties also recognize the delays, expense, and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty):
  - 1. Substantial Completion: Contractor shall pay Owner **\$4,500.00** for each reservoir site for each day that expires after the time (as duly adjusted pursuant to the Contract) specified in Paragraph 4.02.A above for Substantial Completion until the Work is substantially complete.
  - 2. Completion of Remaining Work: After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Times (as duly adjusted pursuant to the Contract) for completion and readiness for final payment, Contractor shall pay Owner **\$4,500.00** for each reservoir site for each day that expires after such time until the Work is completed and ready for final payment.
  - 3. Liquidated damages for failing to timely attain Substantial Completion and final completion are not additive and will not be imposed concurrently.
  - 4. Milestones: Contractor shall pay Owner \$<u>NA</u>for each day that expires after the time (as duly adjusted pursuant to the Contract) specified above for achievement of Milestone 1, until Milestone 1 is achieved.

#### 4.04 Special Damages

A. In addition to the amount provided for liquidated damages, Contractor shall reimburse Owner (1) for any fines or penalties imposed on Owner as a direct result of the Contractor's failure to attain Substantial Completion according to the Contract Times, and (2) for the actual costs reasonably incurred by Owner for engineering, construction observation, inspection, and administrative services needed after the time specified in Paragraph 4.02 for Substantial Completion (as duly adjusted pursuant to the Contract), until the Work is substantially complete. B. After Contractor achieves Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Times, Contractor shall reimburse Owner for the actual costs reasonably incurred by Owner for engineering, construction observation, inspection, and administrative services needed after the time specified in Paragraph 4.02 for Work to be completed and ready for final payment (as duly adjusted pursuant to the Contract), until the Work is completed and ready for final payment.

# **ARTICLE 5 – CONTRACT PRICE**

- 5.01 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents the amounts that follow, subject to adjustment under the Contract:
  - A. For all Work other than Unit Price Work, a lump sum of: \$\_\_\_\_\_.

All specific cash allowances are included in the above price in accordance with Paragraph 13.02 of the General Conditions.

B. For all Unit Price Work, an amount equal to the sum of the extended prices (established for each separately identified item of Unit Price Work by multiplying the unit price times the actual quantity of that item):

Unit Price Work						
ltem No.	Description	Unit	Estimated Quantity	Unit Price	Extended Price	
Total of all Extended Prices for Unit Price Work (subject to final adjustment based on actual quantities)					\$	

The extended prices for Unit Price Work set forth as of the Effective Date of the Contract are based on estimated quantities. As provided in Paragraph 13.03 of the General Conditions, estimated quantities are not guaranteed, and determinations of actual quantities and classifications are to be made by Engineer.

- C. Total of Lump Sum Amount and Unit Price Work (subject to final Unit Price adjustment) \$\_\_\_\_\_.
- D. For all Work, at the prices stated in Contractor's Bid, attached hereto as an exhibit.

#### **ARTICLE 6 – PAYMENT PROCEDURES**

- 6.01 Submittal and Processing of Payments
  - A. Contractor shall submit Applications for Payment in accordance with Article 15 of the General Conditions. Applications for Payment will be processed by Engineer as provided in the General Conditions.

### 6.02 *Progress Payments; Retainage*

- A. Owner shall make progress payments on account of the Contract Price on the basis of Contractor's Applications for Payment on or about the <u>15th</u> day of each month during performance of the Work as provided in Paragraph 6.02.A.1 below, provided that such Applications for Payment have been submitted in a timely manner and otherwise meet the requirements of the Contract. All such payments will be measured by the Schedule of Values established as provided in the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no Schedule of Values, as provided elsewhere in the Contract.
  - 1. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below but, in each case, less the aggregate of payments previously made and less such amounts as Owner may withhold, including but not limited to liquidated damages, in accordance with the Contract
    - a. \_\_\_\_90\_\_\_ percent of Work completed (with the balance being retainage). And
    - b. <u>90</u> percent of cost of materials and equipment not incorporated in the Work (with the balance being retainage).
- B. Upon Substantial Completion, Owner shall pay an amount sufficient to increase total payments to Contractor to <u>100</u> percent of the Work completed, less such amounts set off by Owner pursuant to Paragraph 15.01.E of the General Conditions, and less <u>200</u> percent of Engineer's estimate of the value of Work to be completed or corrected as shown on the punch list of items to be completed or corrected prior to final payment.
- 6.03 Final Payment
  - A. Upon final completion and acceptance of the Work in accordance with Paragraph 15.06 of the General Conditions, Owner shall pay the remainder of the Contract Price as recommended by Engineer as provided in said Paragraph 15.06.

# **ARTICLE 7 – INTEREST**

7.01 All amounts not paid when due shall bear interest at the rate of <u>6</u> percent per annum.

# **ARTICLE 8 – CONTRACTOR'S REPRESENTATIONS**

- 8.01 In order to induce Owner to enter into this Contract, Contractor makes the following representations:
  - A. Contractor has examined and carefully studied the Contract Documents, and any data and reference items identified in the Contract Documents.
  - B. Contractor has visited the Site, conducted a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
  - C. Contractor is familiar with and is satisfied as to all Laws and Regulations that may affect cost, progress, and performance of the Work.
  - D. Contractor has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or adjacent to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the

Supplementary Conditions, especially with respect to Technical Data in such reports and drawings, and (2) reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings.

- E. Contractor has considered the information known to Contractor itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Contract Documents; and the Site-related reports and drawings identified in the Contract Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor; and (3) Contractor's safety precautions and programs.
- F. Based on the information and observations referred to in the preceding paragraph, Contractor agrees that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.
- G. Contractor is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.
- H. Contractor has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.
- I. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.
- J. Contractor's entry into this Contract constitutes an incontrovertible representation by Contractor that without exception all prices in the Agreement are premised upon performing and furnishing the Work required by the Contract Documents.

#### **ARTICLE 9 – CONTRACT DOCUMENTS**

- 9.01 Contents
  - A. The Contract Documents consist of the following:
    - 1. This Agreement (pages 1 to <u>8</u>, inclusive).
    - 2. Performance bond (pages <u>1</u> to <u>3</u>, inclusive).
    - 3. Payment bond (pages <u>1</u> to <u>3</u>, inclusive).
    - 4. Other bonds.
      - a. \_\_\_\_ (pages \_\_\_\_ to \_\_\_\_, inclusive).
    - 5. General Conditions (pages <u>1</u> to <u>65</u>, inclusive).
    - 6. Supplementary Conditions (pages <u>1</u> to <u>18</u>, inclusive).
    - 7. Specifications as listed in the table of contents of the Project Manual.
    - 8. The Drawings listed on the attached sheet index.
    - 9. Addenda (numbers \_\_\_\_\_ to \_\_\_\_, inclusive).
    - 10. Exhibits to this Agreement (enumerated as follows):

a. Contractor's Bid (pages \_\_\_\_\_ to \_\_\_\_, inclusive).

# NOTE(S) TO USER:

- 11. The following which may be delivered or issued on or after the Effective Date of the Contract and are not attached hereto:
  - a. Notice to Proceed.
  - b. Work Change Directives.
  - c. Change Orders.
  - d. Field Orders.
- B. The documents listed in Paragraph 9.01.A are attached to this Agreement (except as expressly noted otherwise above).
- C. There are no Contract Documents other than those listed above in this Article 9.
- D. The Contract Documents may only be amended, modified, or supplemented as provided in the General Conditions.

# ARTICLE 10 – MISCELLANEOUS

- 10.01 Terms
  - A. Terms used in this Agreement will have the meanings stated in the General Conditions and the Supplementary Conditions.
- 10.02 Assignment of Contract
  - A. Unless expressly agreed to elsewhere in the Contract, no assignment by a party hereto of any rights under or interests in the Contract will be binding on another party hereto without the written consent of the party sought to be bound; and, specifically but without limitation, money that may become due and money that is due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract Documents.

### 10.03 Successors and Assigns

- A. Owner and Contractor each binds itself, its successors, assigns, and legal representatives to the other party hereto, its successors, assigns, and legal representatives in respect to all covenants, agreements, and obligations contained in the Contract Documents.
- 10.04 Severability
  - A. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation shall be deemed stricken, and all remaining provisions shall continue to be valid and binding upon Owner and Contractor, who agree that the Contract Documents shall be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.

#### 10.05 Contractor's Certifications

- A. Contractor certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph 10.05:
  - 1. "corrupt practice" means the offering, giving, receiving, or soliciting of any thing of value likely to influence the action of a public official in the bidding process or in the Contract execution;
  - "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process or the execution of the Contract to the detriment of Owner, (b) to establish Bid or Contract prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;
  - 3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish Bid prices at artificial, non-competitive levels; and
  - 4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

#### 10.06 *Other Provisions*

A. Owner stipulates that if the General Conditions that are made a part of this Contract are based on EJCDC<sup>®</sup> C-700, Standard General Conditions for the Construction Contract, published by the Engineers Joint Contract Documents Committee<sup>®</sup>, and if Owner is the party that has furnished said General Conditions, then Owner has plainly shown all modifications to the standard wording of such published document to the Contractor, through a process such as highlighting or "track changes" (redline/strikeout), or in the Supplementary Conditions.

IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement.

This Agreement will be effective on \_\_\_\_\_ (which is the Effective Date of the Contract).

OWNER:		CONTRACTOR:
Guam	Waterworks Authority	
By:	MIGUEL C. BORDALLO, P.E.	Ву:
Title:	General Manager	Title:
		(If Contractor is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.)
Attest:		Attest:
Title:		Title:
Section	00520	Page 8

Address for giving notices:	Address for giving notices:		
Gloria B Nelson Public Service Building			
688 Route 15			
Mangilao, Guam 96913			
	License No.: (where applicable)		
(If Owner is a corporation, attach evidence of authority to sign. If Owner is a public body, attach evidence of authority to sign and resolution or other documents authorizing execution of this Agreement.)			
CERTIFIED FUNDS AVAILABLE:	APPROVED AS TO FORM:		
Ву:	Ву:		
GILDA MAFNAS GWA Chief Financial Officer (Acting)	KELLY O. CLARK GWA General Counsel		
Date:	Date:		
Contract Amount:Contingency:Amount Certified:Funding Source:			

\*Revision 2 changes are shown in red font \*

Special Provision	C-4
Section 011000	Summary Revised Section 1.2, subsection A. 1. Revised Section 1.2, subsection A. 2. Revised Section 1.2, subsection A. 3. Revised Section 1.4, subsection B. 2. Revised Section 1.4, subsection B. 3. Revised Section 1.4, subsection B. 4. Revised Section 1.4, subsection B. 5. Revised Section 1.4, subsection B. 10. Revised Section 1.4, subsection B. 11. Revised Section 1.6, subsection D. 12.
Section 032000	Concrete Reinforcing – Revised Section 2.2
Section 033140	Prestressed Concrete Reservoir – Revised Section 2.2
Section 099000	Painting and Coating – Revised Section 3.16, subsection A
Section 221124	Vertical Multi-Stage Pump and Motor Revised Section 1.5, subsection A
Section 260519	Low-Voltage Electrical Power Conductors and Cables Revised Section 1.4, subsection C. Revised Section 1.4, subsection D. Revised Section 3.2, subsection C.
Section 262923	Variable Frequency Drives Revised Section 2.2
Section 331113	Public Water Utility Distribution Piping Revised Section 2.1, subsection A Revised Section 2.1, subsection B Revised Section 2.3, subsection A
Section 400570	Pressure Reducing and Pressure Sustaining Valves Updated footer Revised Section 2.7, subsection A Revised Section 3.1, subsection B
Section 407910	Miscellaneous Instrument, Instrument Valves and Fittings Revised Section 2.1, subsection K
Guam Waterworks Author Santa Rosa, Sinifa, and S REVISION 2	ority Specifications with Revisions – Table of Contents Santa Rita Reservoirs Page 1

Revised Section 2.2, subsection L Revised Section 2.3, subsection A Revised Section 2.3, subsection E Revised Section 2.5. subsection I Revised Section 2.6, subsection 1 Revised Section 2.6, subsection A Revised Section 2.6, subsection C Revised Section 2.6, subsection E Revised Section 2.6, subsection F Revised Section 2.7, subsection H Revised Section 2.8, subsection H
# SANTA ROSA, SINIFA, AND SANTA RITA RESERVOIRS

## SPECIFICATIONS

FOR

NORTHERN AND SOUTHERN GUAM RESERVOIRS GWA PROJECT NO. W14-007-BND



**GUAM WATERWORKS AUTHORITY** 



### **REVISION 2**

APRIL 23, 2019

#### SANTA ROSA & SINIFA RESERVOIRS – ASSESSMENT

Upon completion and acceptance of the new concrete reservoir, GWA will lower the water level in the existing reservoir by causing the water to be consumed in the water distribution system. When the depth of water in the reservoir has reached a minimum level for draining, GWA will isolate the steel reservoir from the system. The Contractor shall provide the following:

- 1. Drain remaining water in the reservoir through the drain line or by pumping the water out.
- 2. Provide safe access to GWA and its inspectors for entrance into the reservoir. Safe access includes proper fall protection systems, gas monitoring, ventilation systems, and all other necessary equipment.
- 3. Clean by pressure washing the entire floor. All accumulated debris from the floor of the reservoir shall be removed and disposed off-site at a legal landfill. While washing the floor, debris shall not enter the ponding basin.
- 4. Clean by pressure washing 1<sup>st</sup> shell course of the tank interior.
- 5. Provide and erect moveable scaffolding (w/ rubber wheels) inside the reservoir, which reaches to within 6' of the top of the reservoir. The scaffolding shall have platforms at approximately 7' (vertical) intervals to facilitate inspection of the tank shell. Scaffolding shall remain in place while GWA performs inspection and testing of the reservoir shell. The scaffolding shall minimize any damage to the existing coating, if any. If coating is damaged by the Contractor, the Contractor shall repair the coating at his expense.
- 6. Provide a telescopic boom lift, self-powered platform with 500 lb. capacity, with minimum working height of 45 feet. Lift shall be provided for 5 days. Lift will be used by GWA and their consultants for inspection and testing of the exterior reservoir shell. GWA shall notify the Contractor when to mobilize the boom lift onsite.
- 7. After inspections have been completed, Contractor shall remove scaffolding and any remaining debris from inside the reservoir.
- 8. Contactor shall disinfect the reservoir per AWWA standards prior to placing into service.
- 9. The Contractor shall include this effort in the CPM schedule, so that GWA can plan the inspection and testing services well in advance.
- 10. GWA reserves the right to negotiate a change order with the contractor to perform any repairs to the existing reservoir after all inspections have been completed. Repairs may include new reservoir floor, complete interior and exterior coating, cathodic protection system, anchoring system, and all other required work.

#### SECTION 011000 - SUMMARY

#### PART 1 - GENERAL

#### 1.1 SUMMARY

#### A. Section Includes:

- 1. Contract Description
- 2. Work by Owner or Others
- 3. Substantial Completion
- 4. Contractor's Use of Site and Premises
- 5. Work Sequence
- 6. Reports of Physical Conditions
- 7. Permits and Approvals
- 8. Specification Conventions

#### 1.2 CONTRACT DESCRIPTION

- A. The Work of this Contract comprises the site preparation and construction of three 1.0 million gallon reservoirs, and associated work at each site. The work includes work at each of three sites generally described as follows:
  - Santa Rosa reservoir site: demolition of existing facilities, including the existing pump 1. building, chain link fences and gates, fuel tank and containment pit, yard piping, and appurtenances and the construction of the Santa Rosa Water Reservoir No. 2, including one 1.0 million gallon (MG) nominal capacity pre-stressed concrete water tank, a new building housing a control room and booster pump station, earthwork, standby generator and fuel system, site work, piping, utility tie-in connections, protective coatings, flow meters, valves, concrete vaults, concrete retaining walls, concrete headwalls, roadways, fencing, electrical, instrumentation and controls, testing, startup, and appurtenant work, as shown and specified, complete and operable, in accordance with the Contract Documents. Off-site work includes installation of piping and valves at various locations, as indicated on the plans. In addition, the Work includes five additive bid items. The first two additive bid items comprise an intertie between the GWA water system and the Department of Defense (DoD) water system including connections, piping, metering, valves and vaults, as shown on the plans and as specified. The third additive bid item consists of installing approximately 4,042 linear feet of 12" waterline in Route 1, including connections, piping, valves, and fittings, as well as other piping and connections, as shown on the plans and as specified. The fourth additive bid item consists of demolition of the existing steel reservoir, including foundation and appurtenances thereto. The fifth additive bid item consists of removal and disposal of the reservoir foundation oiled sand as hazardous waste if it is so determined. The Work is located as indicated on the plans.

- 2. Santa Rita reservoir site: demolition of existing facilities, including the existing reservoir, chain link fences and gates, yard piping, and appurtenances and the construction of the Santa Rita Water Reservoir, including one 1.0 million gallon (MG) nominal capacity prestressed concrete water tank supported by a pile foundation, a new building housing a control room, earthwork, access road and utility repairs and improvements, site work, piping, utility tie-in connections, protective coatings, flow meters, valves, concrete vaults, concrete headwalls, roadways, fencing, electrical, instrumentation and controls, testing, startup, and appurtenant work, as shown and specified, complete and operable, in accordance with the Contract Documents. In addition, the Work includes two additive bid items. The first additive bid item consists of installation of vaults, piping and valves at various locations, including PRSV stations, as indicated on the plans and as specified. The second additive bid item consists of the removal and disposal of the reservoir foundation oiled sand as hazardous waste if it is so determined. The Work is located as indicated on the plans.
- 3. Sinifa reservoir site: demolition of existing facilities, including the existing reservoir, chain link fences and gates, yard piping, and appurtenances and the construction of the Sinifa Water Reservoir, including one 1.0 million gallon (MG) nominal capacity prestressed concrete water tank, a new building housing a control room, fueling system improvements for existing standby generator, earthwork, access road improvements, site work, reinforced concrete retaining walls, piping, utility tie-in connections, protective coatings, flow meters, valves, concrete vaults, concrete headwalls, roadways, fencing, electrical, instrumentation and controls, testing, startup, and appurtenant work, as shown and specified, complete and operable, in accordance with the Contract Documents. In addition, the Work includes two additive bid items. The first additive bid item consists of demolition and disposal of the existing reservoir, including foundation and appurtenances thereto. The second additive bid item consists of the removal and disposal of the reservoir foundation oiled sand as hazardous waste if it is so determined. The Work is located as indicated on the plans.
- B. Perform Work of Contract under fixed cost Contract with Owner according to Conditions of Contract.
- C. The Work to be performed under this Contract shall consist of furnishing plant, tools, equipment, materials, supplies, and manufactured articles, and furnishing all labor, transportation, and services, including fuel, power, water, and essential communications, and performing all work or other operations required for the fulfillment of the Contract in strict accordance with the Contract Documents. The Work shall be complete, and all work, materials, and services not expressly indicated or called for in the Contract Documents, which may be necessary for the complete and proper construction of the Work in good faith, shall be provided by the Contractor as though originally so indicated, at no increase in cost to GWA.

#### 1.3 WORK BY OWNER OR OTHERS

A. Owner will perform inspection of existing Santa Rosa reservoir in accordance with Special Provision C-4.

#### 1.4 SUBSTANTIAL COMPLETION

A. Substantial Completion is hereby defined as "the time at which the new reservoir(s), piping, pump station, and equipment as defined in the base bid and awarded additive bid items are operational" and can be used for the purpose for which it is intended. This includes completion of the hydrostatic testing, disinfection, calibration of the reservoir instrumentation and controls, calibration of pump system instrumentation and controls, commissioning of the Santa Rosa permanent pumping system and standby generator system, and the reservoir site(s) being fully functional and operable, including other preparations and proof of Guam EPA acceptance, as necessary for owner's use of the reservoir(s), pumps, piping, and equipment to store and distribute potable water.

Base bid substantial completion for Sinifa shall also include fuel system improvements for the existing generator.

Substantial completion for additive bid items for Santa Rosa shall also include the DoD intertie and Route 1 waterline being completed and functional.

Substantial completion for Santa Rita additive bid items shall also include the Pressure Zone Realignment work being completed and functional.

- B. Project Milestones: Include the milestones specified herein as a part of the progress schedule required under Section 013216 Construction Progress Schedule. Following is a detailed description of the project milestones, excluding any delays due to abnormal weather in accordance with Paragraph 1.7 of Section 013216. One Notice to Proceed (NTP) shall be issued for the entire project.
  - 1. Santa Rosa Reservoir No. 2, Base Bid Substantial Completion: The Contractor shall begin work upon issuance of the Notice to Proceed (NTP) and the base bid work shall be substantially completed as specified no later than 395 calendar days from NTP.
  - 2. Santa Rosa Bid Items #7 & #8 (Additive), if awarded, will add thirty (30) calendar days from the NTP to the Santa Rosa Reservoir No. 2 Base Bid Substantial Completion.
  - 3. Santa Rosa Bid Item #9 (Additive), if awarded, will add thirty (30) calendar days from the NTP to the Santa Rosa Reservoir No. 2 Base Bid Substantial Completion.
  - 4. Santa Rosa Bid Item #10 (Additive), if awarded, will add thirty (30) calendar days from the NTP to the Santa Rosa Reservoir No. 2 Base Bid Final Completion.
  - 5. Santa Rosa Bid Item #11 (Additive), if awarded, will add zero (0) calendar days from the NTP to the Santa Rosa Reservoir No. 2 Base Bid Substantial Completion
  - 6. Santa Rita Reservoir Base Bid Substantial Completion: The Contractor shall begin work upon issuance of the Notice to Proceed (NTP) and the base bid work shall be substantially completed as specified no later than 425 calendar days from NTP.
  - 7. Santa Rita Bid Item #7 (Additive), if awarded, will add thirty (30) calendar days from the NTP to the Santa Rita Reservoir Base Bid Substantial Completion.
  - 8. Santa Rita Bid Item #8 (Additive), if awarded, will add zero (0) calendar days from the NTP to the Santa Rita Reservoir Base Bid Substantial Completion.
  - 9. Sinifa Reservoir Base Bid Substantial Completion: The Contractor shall begin work upon issuance of the Notice to Proceed (NTP) and the base bid work shall be substantially completed as specified no later than 365 calendar days from NTP.
  - 10. Sinifa Bid Item #6 (Additive), if awarded, will add thirty (30) calendar days from the NTP to the Sinifa Reservoir Base Bid Final Completion.
  - 11. Sinifa Bid Item #7 (Additive), if awarded, will add zero (0) calendar days from the NTP to the Sinifa Reservoir Base Bid Substantial Completion.

- C. GWA shall have the right to utilize or place into service any item of equipment or other usable portion of the Work prior to completion of the Work. Whenever GWA plans to exercise said right, the Contractor will be notified in writing by GWA, identifying the specific portion or portions of the Work to be so utilized or otherwise placed into service.
  - 1. It shall be understood by the Contractor that until such written notification is issued, all responsibility for care and maintenance of all of the Work shall be borne by the Contractor. Upon issuance of said written notice of Substantial Completion, GWA will accept responsibility for the protection and maintenance of all such items or portions of the Work described in the written notice.
- D. Liquidated Damages for delays relative to Substantial Completion work: As liquidated damages, and not as a penalty, for Contractor's delays in substantial completion of the Work beyond the dates agreed upon in accordance with the Contract Documents or within such extensions of time as may be granted by GWA, the Contractor shall pay GWA fixed and liquidated damages for each calendar day(s) delay until said Work is satisfactory completed at the rate of \$4,500 per day per reservoir site.
- E. Final Completion: Final Completion is defined as completing and having GWA accept all Work required under this Bid. Work includes warranty work, replacement work and warranty periods required by law or this bid. Final Completion shall be no later than 60 calendar days following Substantial Completion. Include the Final Completion date as a project milestone of the progress schedule required under Section 013216 – Construction Progress Schedule.

#### 1.5 CONTRACTOR'S USE OF SITE AND PREMISES

- A. Limit use of Site and premises to allow:
  - 1. Owner occupancy of existing Santa Rosa No. 1 Reservoir, Booster Pump Building, Generator Building, and yard piping.
  - 2. Owner occupancy of existing Santa Rita reservoir site.
  - 3. Owner occupancy of the existing Sinifa Reservoir, Booster Pump Building and yard piping.
  - 4. GWA, or another GWA Contractor, may utilize any part of the Site. The Contractor shall cooperate and coordinate with GWA or their contractors to facilitate GWA's operations and to minimize interference with the Contractor's operations at the same time. In any event, GWA and their contractors shall be allowed access to the site during period of construction.
  - 5. See other requirements in Article 5 of the Standard General Conditions of the Construction Contract.
- B. Time Restrictions for Performing Work: All work shall be performed during regular working hours, unless otherwise approved by GWA.
- C. Access to the site is limited to the hours between 7:00 AM and 5:00 PM, Monday to Friday except for legal holidays, unless otherwise approved by GWA. The Contractor shall not permit the performance of Work requiring special inspections or QA testing on Saturday, Sunday, or any legal holidays without GWA's written consent given after submitting prior written request to the Construction Manager a minimum of 72 hours in advance. Construction Operations:

- 1. Limited to areas indicated on Drawings.
- 2. The Contractor's use of the Site shall be limited to its construction operations, including on-Site storage of materials, on-Site fabrication facilities, and field offices.
- 3. Contractor shall be responsible for all areas of the Site used by him or his Subcontractors in the performance of the Work. Contractor shall exert full control over the actions of all employees and other persons with respect to the use and preservation of property and existing facilities, except such controls as may be specifically reserved to GWA or others. Contractor has the right to exclude from the Site all persons who have no purpose related to the Work or its inspection and may require all persons on the Site (except GWA's employees or representatives) to observe the same regulations as he requires of his employees.
- 4. GWA does not warrant the condition of any existing pipeline or facility. The Contractor is cautioned that any fit-ups and connections to existing facilities may require a substantial amount of fit-up Work. The Contractor shall be solely responsible for performing all work and for furnishing all materials, labor and equipment necessary to complete the Work. The Contractor shall make necessary survey measurements of existing facilities prior to the shutdown or staging to ensure proper fit-up.
- 5. The Contractor shall incorporate the construction and schedule constraints of this Section in preparing the construction schedules required under Section 013216 Construction Progress Schedule. The schedules shall include the Contractor's activities necessary to satisfy all constraints of the Contract Documents.
- D. Utility Outages and Shutdown:
  - 1. The Contractor shall schedule and conduct activities to enable the existing facilities to operate continuously, unless other specified.
  - 2. Modifications to existing facilities may require the temporary outage of existing water system service. In such cases, the Contractor shall coordinate Work with the Construction Manager and GWA. The Contractor shall complete the GWA Scheduled Outage Request Form.
  - 3. The Contractor shall perform Work continuously during critical connections and changeovers, and as required to prevent or minimize interruption of GWA's operations. When necessary, plan, design, and provide various temporary services, utilities, connections, temporary piping and heating, access, and similar items to maintain continuous operations of GWA's facilities at no additional cost to GWA.
  - 4. The Contractor shall not close lines, open or close valves, or take other action which would affect the operation of existing systems. Only GWA staff is authorized to operate existing equipment, valves and systems; and such request by the Contractor will be considered within 48 hours after receipt of Contractor's written request.
  - 5. In addition to the construction schedule required under Section 013216 Construction Progress Schedule, the Contractor shall submit a detailed outage plan and time schedule for all construction activities which will make it necessary to remove a tank, pump station, pipeline, electrical circuit, equipment, structure, road or other facilities from service. The Contractor shall schedule all connections to existing facilities with GWA and the interruption to system operations and services shall be held to a minimum.
  - 6. The outage plans shall be coordinated with, and incorporated into, the overall construction schedule and shall meet the restrictions and conditions of this Section.
  - 7. The removal of existing system from service and reconnect the pipelines to resume service shall be completed in no more than 8 hours or otherwise approved time duration by GWA for each shutdown. The Contractor shall perform all cutting, patching, and connection to existing facilities with extreme care and take precautions to ensure existing

facilities are not damaged. Any damages shall be repaired by the Contractor at no additional cost to GWA. The Contractor shall pay costs for GWA employees that are needed onsite due to the Contractor damaging any of GWA's facilities and water lines. The Contractor shall be responsible for dewatering of the existing lines and disposal of water as required at no additional cost to GWA.

- 8. The outage plans shall be submitted to GWA and the Construction Manager for acceptance a minimum of fourteen (14) calendar days in advance of the time that such outages are required. The outage plan shall describe the Contractor's methods; the length of time required to complete said operations; any necessary temporary power, controls, lighting, instrumentation or alarms required to maintain control and monitoring for the water system; safety requirements, and the manpower, plant, and equipment which the Contractor shall provide in order to ensure proper operation of associated water system. All cost for preparing and implementing the outage plans shall be at no increase in cost to GWA. The Contractor shall pay cost for GWA employees to facilitate and monitor outages outside normal working hours.
- 9. The Contractor shall not begin an alteration affecting existing facilities until specific written approval has been granted by GWA in each case. The Contractor shall coordinate the planned procedures with GWA. GWA and the Construction Manager have the authority to modify any proposed shutdown procedures if such procedures would adversely impact the water system operations.
- 10. GWA and the Construction Manager shall be notified in writing at least seven (7) calendar days in advance of the required outage if the schedule for performing the work has changed or if revisions to the outage plan are required. GWA and the Construction Manager have the authority to cancel the outage if a written notice for change or revisions has not been submitted.
- 11. The Contractor shall provide written confirmation of the shutdown date and time two (2) working days prior to the actual shutdown.
- 12. During each shutdown period, the Contractor shall complete the work that can be done only while the facility is out of operation and other work that is necessary to allow the shutdown facility to be returned to service at the end of the shutdown period.
- 13. GWA does not warrant the condition of any existing pipeline or facility. The Contractor is cautioned that any fit-ups and connections to existing facilities may require a substantial amount of fit-up Work. The Contractor shall be solely responsible for performing all work and for furnishing all materials, labor and equipment necessary to complete the Work. The Contractor shall make necessary survey measurements of existing facilities prior to the shutdown or staging to ensure proper fit-up.
- 14. GWA, GPA, and other contractors may be performing construction, maintenance or operation activities during the shutdowns. Prior to a shutdown or tie-in, the Contractor shall coordinate its activities with those of GWA, GPA, and other contractors to ensure adequate safety, coordination and cooperation during the shutdown.

#### 1.6 WORK SEQUENCE

- A. Work shall be performed in a manner and in stages as determined by the Contractor to comply with the Conditions of the Contract.
- B. Work shall be scheduled, sequenced, and performed in a manner that minimizes disruption to the public.

- C. Sequencing of Construction Plan: Before start of construction, submit three copies of the construction plan regarding phasing for acceptance by Owner. After acceptance of plan, construction sequencing shall comply with accepted plan unless deviations are accepted by the Construction Manager in writing.
- D. Major Construction Sequencing Elements: The following list of main construction sequencing elements is not all inclusive and is not intended to be a comprehensive description of all Work. Both base bid and additive bid items are included. Additive bid items shall be disregarded if not awarded. The Contractor shall review the list and ensure that each item, if awarded, is adequately considered and addressed in his construction schedule and work plan. Some elements may be constructed concurrently, if so indicated and approved in the Contractor's sequencing plan. It is the responsibility of the Contractor to identify and complete all related Work that is required to comply with the stated sequence.
  - 1. Mobilize on each site.
  - 2. Implement the Storm Water Pollution Prevention Plan ("SWPPP") and the erosion and sediment control measures.
  - 3. Construct temporary and/or permanent fencing to secure the project site.
  - 4. Construct repairs to Santa Rita access road, including utilities in the road.
  - 5. Demolish Santa Rita reservoir, yard piping, and appurtenances
  - 6. Construct mass grading, retaining walls, access roads, and drainage control systems.
  - 7. Design and construct Santa Rosa temporary booster pump station before decommissioning and demolition of existing booster pump station and building.
  - 8. Construct new Santa Rosa booster pump station building, pumps, controls, standby generator and fuel system, and appurtenances.
  - 9. If awarded, construct offsite Santa Rita Pressure Zone Realignment work including PRV stations, valve and piping work, in sequence specified, and as shown on the plans.
  - 10. Construct new reservoirs, including piping, vaults and valves and appurtenances, electrical, instrumentation and controls, testing and disinfection.
  - 11. If awarded, construct Santa Rosa Additive Bid Items DoD InterTie, including piping, valves, vaults, metering, instrumentation, and tie-ins, and Route 1 waterline.
  - 12. Provide for Owner inspection of existing Santa Rosa & Sinifa reservoirs, as specified.
  - 13. Complete all remaining work and project closeout, including pavement, roadways, fencing, drainage facilities, finished grading, final seeding and all other Work as required to allow for substantial completion within the timelines specified.

#### 1.7 REPORTS OF PHYSICAL CONDITIONS

A. Subsurface Exploration: In the preparation of the Contract Documents, the Engineer has relied upon the following report of explorations and tests of subsurface conditions at the Site in the preparation of the Contract Documents:

Santa Rosa Reservoir:

1. Report dated 12 September 2018 entitled "Subsurface Soil Investigation, Design of Northern and Southern Reservoirs, Santa Rosa Reservoir Replacement, Yigo, Guam" prepared by Geo-Engineering & Testing, Inc.

Santa Rita Reservoir:

1. Report dated 12 September 2018 entitled "Subsurface Soil Investigation, Design of Northern and Southern Reservoirs, Santa Rita Reservoir Replacement, Santa Rita, Guam" prepared by Geo-Engineering & Testing, Inc.

Sinifa Reservoir:

- 1. Report dated 07 September 2018 entitled "Subsurface Soil Investigation, Design of Northern and Southern Reservoirs, Sinifa Reservoir Replacement, Santa Rita, Guam" prepared by Geo-Engineering & Testing, Inc.
- B. Existing Structures: In the preparation of the Contract Documents, the Engineer has relied upon the following drawings of physical conditions in or relating to the existing surface and subsurface structures, which are at or contiguous to the Site that have been utilized in the preparation of the Contract Documents:

Santa Rosa Reservoir Site:

- 1. PUAG: "Northern District Water System Addition, Phase III, Package B&C", PUAG DWG NO. W80-004, dated 6/23/84 "As-Built", Sheets 7 to 13 only.
- 2. PUAG: "Water System Improvement for Mt. Santa Rosa (Upper) Yigo", PUAG DWG NO. W88-001-LOC, dated 7/11/88.
- 3. USCOE, Guam District: "North Field, Guam, M.I., Water Supply, 2 M.G. Water Reservoir, Mount Santa Rosa", Record Drawing, dated 15, Sept. 1948.
- 4. Anderson Air Force Base: "Project Number AJJW 07-1144, Construct Bypass Waterline, Santa Rosa, AAFB, Guam, M.I.", dated 24 Sept. 2009.

Santa Rita Reservoir Site:

- 1. GWA: "Santa Rita Tank", by DCA, 2 sheets, site plan and details, undated.
- 2. GWA: "Santa Rita 12-Inch Water Transmission Line Along Route 5 and Route 12, GWA No W02-030-LOC, by Duenas Bordallo & Assoc, As-Built, undated.
- 3. GWA: "Santa Rita Springs Booster Pump Station Rehabilitation Project and Transmission Line, GWA No W02-030-EPA, Duenas & Assoc., July 2006.

Sinifa Reservoir Site:

- 1. PUAG: "Guam Water System, Sinifa Water System, Municipality of Agat", by Juan C Tenorio, undated, Shts C-15 to C-19 only.
- 2. Henry Simpson: "Booster Pump Installation at Sinifa Tank Site", by DCA, Sht C-1 only, dated 11/2010.
- 3. GWA: Sinifa Pump Station, "As Built", by Sherwin Maximo, two sheets only. undated, unsigned.
- C. These reports and drawing are not part of the Contract Documents. Neither GWA nor the Engineer makes any representation as to the completeness of the reports or drawings referred to above or the accuracy of any data or information contained herein. The Contractor may rely upon the accuracy of the technical data contained in such reports and drawings, except for such physical dimensions that can be field verified; however, the interpretation of such technical data, including any interpolation or extrapolation thereof, and opinions contained in such reports and drawings are not to be relied on by the Contractor.
- D. Data and information made available in these documents are for the Contractor's information. GWA assumes no responsibility for any interpretation of or conclusion drawn from the data or information by the Contractor.

#### 1.8 PERMITS AND APPROVALS

- A. The Contractor shall be responsible to furnish and pay fees for all necessary documents, permits and approvals for construction of Work including, but not limited to, the following:
  - 1. Building permit
  - 2. Clearing and grading permit
  - 3. Demolition permit
  - 4. Dewatering permit
  - 5. Highway encroachment permit
  - 6. Temporary and permanent power permit
  - 7. Temporary water permit
  - 8. Utility clearances
  - 9. Disposal permit
  - 10. Stockpiling permit
  - 11. Stormwater and erosion control permit
  - 12. Environmental Protection Plan approval
  - 13. Stormwater Pollution Prevention Plan approval
- B. The Contractor shall abide by the conditions of all permits and shall obtain proof of satisfaction of conditions from the issuers of permits prior to acceptance of the Work by the Owner

#### 1.9 SPECIFICATION CONVENTIONS

- A. These Specifications are written in imperative mood and streamlined form. This imperative language is directed to Contractor unless specifically noted otherwise. The words "shall be" are included by inference where a colon (:) is used within sentences or phrases.
- B. Omissions of such words and phrases as "The Contractor shall," "in conformity therewith," "shall be", "as shown on the Drawings," "a," "an," "the," and "all" are intentional in streamlined sections.
  - 1. Omitted words shall be supplied by inference in the same manner as when a note appears on the Drawings.
  - 2. Omission of such words shall not relieve the Contractor from providing items and Work described herein or indicated on the Drawings.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION 011000

#### SECTION 032000 - CONCRETE REINFORCING

#### PART 1 - GENERAL

#### 1.1 DESCRIPTION

A. This section covers reinforcement for cast-in-place and precast concrete.

#### 1.2 **REFERENCES**

The publications listed below form part of this specification to the extent referenced and are referred to in the text by the basic designation only. Reference shall be made to the latest edition of said standards unless otherwise called for.

ACI 301	Structural Concrete for Buildings
ACI 315	Details and Detailing of Concrete Reinforcement
ACI 318	Building Code Requirements for Reinforced Concrete
ACI 350	Code Requirements for Environmental Engineering Concrete Structures
CRSI MSP-1	Concrete Reinforcing Steel Institute Manual of Standard Practice
WRI	Manual of Standard Practice for Welded Wire Fabric
AWA D1.4	Structural Welding Code – Reinforcing Steel
ASTM A 82	Specification for Welded Steel Wire, Plain, for Concrete Reinforcement
ASTM A 185	Specification for Welded Steel Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 615	Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 706	Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 767	Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
ASTM A 775	Specification for Epoxy-Coated Reinforcing Steel Bars
AWS D1.4	Structural Welding Code for Reinforcing Steel

#### 1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 013300, Submittal Procedures
- B. Section 031000, Concrete Formwork in Reservoir

- C. Section 033010, Cast-in-Place Concrete in Reservoir
- D. Section 033140, Prestressed Concrete Reservoir

#### 1.4 SUBMITTALS

- A. General: Submittals shall be furnished in accordance with Section 01300 Submittal Procedures.
- B. The Contractor shall furnish shop drawings, bending diagrams, placing lists, and drawings of all reinforcement steel before fabrication.
- C. Details of the concrete reinforcement steel and concrete inserts shall be submitted at the earliest possible date after receipt of the Notice to Proceed. Details of reinforcement steel for fabrication and erection shall conform to ACI 315 and the requirements indicated. The shop drawings 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 location, spacing, and dimensions of each bar splice.
- D. 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.
- E. If reinforcement steel is spliced by welding at any location, the Contractor shall submit mill test reports which shall include the information necessary for the determination of the carbon equivalent 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.
- F. Contractor shall submit all reinforcing for a given structure in a single submittal at one time. Partial reinforcing submittals may be returned to the Contractor or rejected for incompleteness.

#### 1.5 QUALITY ASSURANCE

- A. If requested by the Contracting Officer, the Contractor shall provide samples from each heat of reinforcement steel delivered in a quality adequate for testing. Costs of tests will be paid by the Contractor.
- B. If reinforcement steel is spliced by welding at any location, the Contractor shall submit certifications of procedure qualifications for each welding procedure used and certification of welder qualifications, for each welding procedure, and for each welder performing the work. Such qualifications shall be as specified in AWS D1.4.

C. If requested by the Engineer, the Contractor shall provide samples of each type of welded splice used in the work in a quantity and of dimensions adequate for testing. At the discretion of the Engineer, radiographic testing of direct butt-welded splices will be performed. The Contractor shall provide assistance necessary to facilitate testing. The Contractor shall repair any weld which fails to meet the requirements of AWA D1.4. The costs of testing will be paid by GWA; except, the costs of all tests which fail to meet specified requirements shall be paid by the Contractor at no additional cost to GWA.

#### 1.6 INSPECTION

- A. All work hereunder shall be subject to continuous inspection by a Special Inspector selected by GWA and approved by the local Building Official having jurisdiction. Special Inspection shall be performed in accordance with the International Building Code. The Special Inspector shall work under the direct supervision of the Engineer. All costs of such inspection shall be borne by the Contractor and shall be included in the price bid for completion of the work.
- B. The Special Inspector shall observe and inspect work for conformance with the design drawings and specifications.

#### PART 2 - PRODUCTS

#### 2.1 MATERIAL REQUIREMENTS

Materials specified in this Section which may remain or leave residues on or within the concrete shall be classified as acceptable for potable water use within 30 days of application or use by the Environmental Protection Agency.

#### 2.2 MATERIALS

Bars, Except Weldable	ASTM A615, Grade 60, deformed.	
Galvanized Bars (Reservoir Only Including Piles)	ASTM A767	
Bars, Weldable	ASTM A706 or A615, Grade 60, deformed, with maximum carbon equivalent of 0.55%.	
Column Spirals	ASTM A82, cold drawn wire.	
Welded Wire Fabric	ASTM A185 or A497.	
Bar Supports	CRSI Class 1, plastic protected; or Class 2, stainless steel protected mortar blocks, ferrous metal chairs, spacers, metal hangers, or supporting wires. Do not use aluminum, plastic, or wood supports, unless noted	

otherwise.

Tie Wire	Annealed steel, 14 gage minimum.
Mechanical Connections	Classified Type 2 per ACI 318. Dayton/Richmond "Dowel Bar Splicer" or
	"Coupler Splice" System, Bar-Lock
	"Coupler Systems" or Barsplice Products or
	Lenton by Erico.

#### 2.3 REINFORCEMENT

Reinforcement shall be accurately formed and shall be free from loose rust, scale, concrete splatter, and contaminants which reduce bond. Unless otherwise indicated on the drawings or specified herein, the details of fabrication shall conform to ACI 350 (for Reservoir).

- A. Splices. Splices shall conform to the details indicated on the drawings. Splices at locations other than those indicated on the drawings shall be submitted to Engineer for review and concurrence.
- B. Mechanical Connections. Mechanical connections shall be used only as indicated on the drawings. Connections in adjacent bars shall be spaced at least 30 inches apart.
- C. Welding. Except where indicated on the drawings, welding or tack welding of reinforcement is not permitted. Preheating and welding shall conform to AWS D1.4. Reinforcement which has been welded improperly or without Engineer's concurrence shall be removed and replaced.
- D. Epoxy Grout. Epoxy for grouting reinforcing bars shall be specifically formulated for such application, for the moisture condition, application temperature, and orientation of the hole to be filled.

#### PART 3 - EXECUTION

#### 3.1 STORAGE AND HANDLING

Reinforcing steel shall be carefully handled and shall be stored on supports which prevent the steel from touching the ground.

#### 3.2 FABRICATION

- A. General.
  - 1. Reinforcement steel shall be accurately formed to the dimensions and shapes shown, and the fabricating details shall be prepared in accordance with ACI 315 and ACI 318, except as modified by the Drawings. Stirrups and tie bars shall be bent around a pin having diameter not less than 1-1/2-inch for No. 3 bars, 2-inch for No. 4 bars, and 2-1/2-inch for No. 5 bars. Bends for other bars shall be made around a pin having a diameter not less than 6 times the bar diameter, except for

**REVISION 2** 

bars larger than 1 inch, in which case the bends shall be made around a pin of 8 bar diameters. Bars shall be bend cold.

- 2. The Contractor shall fabricate reinforcement bars for structures in accordance with bending diagrams, placing lists, and placing drawings. Said drawings, diagrams, and lists shall be prepared by the Contractor as specified under the Submittals Section.
- B. Fabricating Tolerances.
  - 1. Bars used for concrete reinforcement shall meet the following requirements for fabricating tolerances:

Sheared length:	$\pm$ 1-inch.
Depth of truss bars:	+ 0, -1/2-inch
Stirrups, ties, and spirals:	$\pm \frac{1}{2}$ -inch
All other bends:	$\pm 1$ -inch

#### 3.3 PLACEMENT

- A. Firmly and securely hold reinforcement in position by: 1) Wiring at intersections and splices and 2) Using precast mortar blocks, ferrous metal chairs, spacers, metal hangers, or supporting wires strong enough to resist crushing under applied loads. Do not use aluminum, plastic, or wood supports.
- B. Where reinforcement is placed in two or more layers, the bars in the upper layer shall be placed directly above the bars in the lower layer.
- C. Reinforcement for beams or slabs which are supported by concrete columns shall not be installed until after the concrete for the column has been placed.
- D. Before concrete is placed, reinforcement shall be rigidly secured in proper position. All surfaces encrusted with dried concrete from previous placements shall be cleaned and the entire installation shall be acceptable to Engineer. Remove all frost, ice, and snow before concrete is placed.
- E. Reinforcing shall be accurately positioned around pipe opening to conform to the required tolerances. Placement of reinforcing mats without required pipe openings followed by field cutting of mat to clear pipe flange shall not be permitted, unless shown on the Drawings or approved by the Engineer.
- F. Limitations on the use of bar support materials shall be as follows:
  - 1. Concrete Dobies: permitted at all locations except where architectural finish is required.
  - 2. Wire Bar Supports: permitted only at slabs over dry areas, interior dry wall surfaces, and exterior wall surfaces.

- 3. Plastic Bar Supports: permitted at all locations except on grade.
- G. Tie wires shall be bent away from the forms in order to provide the specified concrete coverage.
- H. 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 his own expense.
- I. Unless otherwise specified, reinforcement placing tolerances shall be within the limits specified in Section 7.5 of ACI 318 or ACI 350 as applicable, except where in conflict with the requirements of the Building Code.
- J. 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 as acceptable to the Engineer.
- K. Welded wire fabric reinforcement placed over horizontal forms shall be supported on slab bolsters. Slab bolsters shall be spaced not more than 30 inches on centers, shall extend continuously across the entire width of the reinforcement mat, and shall support the reinforcement mat in the plane shown.
- L. Welded wire fabric placed over the ground shall be supported on wired concrete blocks (dobies) spaced not more than 3 feet on centers in any direction. The construction practice of placing welded wire fabric on the ground and hooking into place in the freshly placed concrete shall not be used.
- M. Epoxy coated reinforcing bars shall be stored, transported, and placed in such a manner as to avoid chipping of the epoxy coating. Non-abrasive slings made of nylon and similar materials shall be used. Specially coated bar supports shall be used. All chips or cracks in the epoxy coating shall be repaired with a compatible epoxy repair material prior to placing concrete.
- N. Accessories supporting reinforcing bars shall be spaced such that there is no deflection of the accessory form 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.

#### 3.4 SPACING OF BARS

- A. The clear distance between parallel bars (except in columns and between multiple layers of bars in beams) shall be not less than the nominal diameter of the bars nor less than 1-1/3 times the maximum size of the coarse aggregate, nor less than one inch.
- B. Where reinforcement in beams or girders is placed in 2 or more layers, the clear distance between layers shall be not less than one inch.

Guam Waterworks Authority Santa Rosa, Sinifa, and Santa Rita Reservoirs

- C. In columns, the clear distance between longitudinal bars shall be not less than 1-1/2 times the bar diameter, nor less than 1-1/2 times the maximum size of the coarse aggregate, nor less than 1-1/2 inches.
- D. The clear distance between bars shall also apply to the distance between a contact splice and adjacent splices or bars.

#### 3.5 SPLICES

- A. General
  - 1. Reinforcement bar splices shall only be used at locations shown. When it is necessary to splice reinforcement at points other than where shown, the character of the splice shall be as acceptable to the Engineer.
  - 2. Unless otherwise indicated, dowels shall match the size and spacing of the spliced bar.
- B. Splices of Reinforcement.
  - 1. The length of lap for reinforcement bars, unless otherwise shown shall be in accordance with ACI 318 or ACI 350 as applicable, Section 12.15 for a Class B, Splice.
  - 2. Laps of welded wire fabric shall be in accordance with the ACI 318. Adjoining sheets shall be securely tied together with No. 14 tie wire, one tie for each 2 running feet. Wires shall be staggered and tied in such a manner that they cannot slip.
  - 3. Splices in column spiral reinforcement, when necessary, shall be made by welding or by a lap of one full revolution.
- C. Bending or Straightening. Reinforcement shall not be straightened or rebent in a manner which will injure the material. Bars with kinks or bends not shown shall not be used. All bars shall be bend cold, unless otherwise permitted by the Engineer. No bars partially embedded in concrete shall be field-bent except as shown or specifically permitted by the Engineer.
- D. Couplers which are located at a joint face shall be a type which can be set either flush or recessed from the face as shown. The couplers shall be sealed during concrete placement to completely eliminate concrete or cement paste from entering. Couplers intended for future connections shall be recessed a minimum of 1/2-inch from the concrete surface. After the concrete is placed, the coupler shall be plugged with plastic plugs which have an O-ring seal and the recess filled with sealant to prevent any contact with water or other corrosive materials. Threaded couplers shall be plugged.
- E. Unless noted otherwise, mechanical coupler spacing and capacity shall match the spacing and capacity of the reinforcing shown for the adjacent section.

#### 3.6 CLEANING AND PROTECTION.

Guam Waterworks Authority Santa Rosa, Sinifa, and Santa Rita Reservoirs

- A. Reinforcement steel shall at all times be protected from conditions conducive to corrosion until concrete is placed around it.
- B. The surfaces of all reinforcement steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar and other foreign substances immediately before the concrete is placed. Where there is delay in depositing concrete, reinforcement shall be reinspected by the Contracting Officer and, if necessary, recleaned.

#### 3.7 EMBEDMENT OF DRILLED REINFORCING STEEL DOWELS

- A. Drill and Bond Dowels.
  - 1. Drill the holes without damaging the adjacent concrete. Holes for bonded dowels must be ½ inch larger than the nominal dowel diameter.
  - 2. Leave dowels undisturbed for 3 hours or until dowels can be supported by the concrete.
  - 3. Replace dowels that fail to bond or are damaged.
- B. Drill and Grout Dowels
  - 1. Drill holes <sup>1</sup>/<sub>4</sub> inch larger than the nominal dowel diameter. Immediately before placing dowels, holes must be cleaned, be thoroughly saturated with water, have all free water removed, and be dried to a saturated surface dry condition.
  - 2. Place grout holes and insert dowels. Retempering of grout is not allowed. Cure grout at least 3 days or until the dowels are encased in concrete. Immobilize the dowels during the curing period. Cure using curing compound method or by keeping the surface continuously damp.
- C. Drill and Bond Dowels (Chemical Adhesive)
  - 1. The drilled hole diameter and depth must comply with the ICC evaluation report for the size of dowel being installed unless otherwise directed by the Structural Engineer. Increase the drilled hole depth specified in the ICC evaluation report by 50-percent if the dowels are epoxy coated. Clean hole as recommended by the epoxy manufacturer.
  - 2. Epoxy shall be injected into the hole through a tube placed to the bottom of the hole. The tube shall be withdrawn as epoxy is placed but kept immersed to prevent formation of air pockets. The hole shall be filled to a depth that insures that excess material will be expelled from the hole during dowel placement.
  - 3. Dowels shall be twisted during insertion into the partially filled hole so as to guarantee full wetting of the bar surface with epoxy. The bar shall be inserted slowly enough to avoid developing air pockets.
  - 4. Adhesive shall be Hilti HY-200, Simpson SET or I.C.C. approved equal.

5. Drilled reinforcing dowels shall only be used where specifically detailed on the Drawings or when permitted by the Engineer in writing.

END OF SECTION 032000

#### SECTION 033140 – PRESTRESSED CONCRETE RESERVOIR

#### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. This section covers the complete furnishing and installation of seven-wire strand and bars for circumferential and vertical prestressing, respectively, of concrete walls and the complete shotcreting operations for the construction of the AWWA D110 Type I circumferentially strand wrapped prestressed concrete tank, complete and operable, in accordance with the Contract Documents.
- B. This section covers general requirements for the tank and construction materials used in the AWWA D110 Type I circumferentially strand wrapped prestressed concrete tank and the qualifications for the Tank Subcontractor. In the event of a discrepancy between this section of the Specifications and any other section of the Specifications, this section shall govern.
- C. The tank shall conform to the dimensions and be equipped with the appurtenances shown on the Drawings and as specified herein.
- D. The Tank Subcontractor shall furnish and construct the AWWA D110 Type I circumferentially strand wrapped prestressed concrete reservoir of the capacity shown on the Drawings, consisting of a concrete roof with concrete support columns, concrete floor and a poured-in-place concrete core wall, post-tensioned vertically with steel tendon rods and circumferentially with wrapped strand protected with several coats of shotcrete and paint.
- E. The reservoir shall conform to the dimensions and be equipped with the appurtenances shown on the Drawings and as specified herein.
- F. Concrete work shall conform to the provisions of section 033010, Cast-in-Place Concrete in Reservoir, as supplemented and modified by this section.
- G. The words "stressing machine" may refer to either circumferential wrapping machinery or vertical threadbar stressing equipment.
- H. **Tank Subcontractor Definition:** Due to the critical and complex technical requirements of this project, the prestressed concrete tank specified in this Section shall be furnished by a single Tank Subcontractor. The Tank Subcontractor shall be a single firm, or corporation to assume full responsibility through the Contractor to perform all

engineering and construction and place into operation the AWWA D110 Type I circumferentially strand wrapped prestressed concrete tank facility, for a complete functional and operable facility. The Tank Subcontractor shall be a firm that specializes in and meets the requirements as defined in paragraphs 1.5, 1.6 and 1.7 of this Specification and the Tank Subcontractor shall have in its employ an experienced engineering and technical staff in the construction of the AWWA D110 Type I circumferentially strand wrapped prestressed concrete prestressed concrete tank.

#### 1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 013300, Submittal Procedures
- B. Section 031000, Concrete Formwork and Accessories in Reservoir
- C. Section 032000, Concrete Reinforcement
- D. Section 032300, Base Restraint Cables
- E. Section 032510, Expansion and Construction Joints
- F. Section 032550, Reservoir Wall Base and Top Joint
- G. Section 033010, Cast-in-Place Concrete in Reservoir

#### 1.3 REFERENCE STANDARDS

- A. The publications listed below form part of this specification to the extent referenced and are referred to in the text by the basic designation only. Reference shall be made to the latest edition of said standards unless otherwise called for.
- B. Commercial Standards
  - 1. American Concrete Institute
    - ACI 506 Guide to Shotcrete
  - 2. ASTM International (ASTM)

ASTM A416 Specifications for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete

Guam Waterworks Authority Santa Rosa, Sinifa, and Santa Rita Reservoirs REVISION 2 Prestressed Concrete Reservoir Section 033140 - Page 2

ASTM A722	Specifications for Uncoated High-Strength Bar for Prestressed Concrete
ASTM C1116	Specification for Fiber-Reinforced Concrete and Shotcrete
ASTM C173	Test Method for Air Content of Freshly Mixed Concrete by the Volumetric method
ASTM C231	Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

#### 1.4 SUBMITTALS

- A. General: Submittals shall be in accordance with the requirements of Section 013300, Submittal Procedures.
- B. Tank Subcontractor shall submit shop drawings of the circumferential prestressing wrapping schedule and the intermediate lock-off elevations before the wall pour is made.
- C. Tank Subcontractor shall submit results of trial batch testing of proposed shotcrete mix to the Contracting Officer for review and approval prior to commencing shotcreting operation.
- D. A testing plan and schedule, including methods for water conveyance, control, disposal, and disinfection shall be submitted in writing for approval. The testing plan shall be submitted for approval a minimum of ten (10) workdays before testing is to start, including at least the following information:
  - 1. Testing schedule.
  - 2. The hydraulic structure to be tested.
  - 3. Proposed plans for water conveyance, control, and disposal.
  - 4. Method of isolation.
  - 5. Means and method of measuring water level, water temperature, evaporation loss, precipitation gain, and locations where the measurement will be taken.
  - 6. Method and procedures of disinfection.

- 7. Method and procedures of dechlorination.
- 8. Name of certified bacteriologist testing laboratory.
- 9. Resume of experienced technician, if liquid chlorine is proposed.

#### 1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Prestressing steel shall be adequately packaged against intrusion of chemical contaminants (from the atmosphere or otherwise) for the protection of the steel against physical damage and corrosion during (and subsequently as the result of) shipping and storage.
- B. Prestressing steel that has sustained physical damage through rust or otherwise will be rejected.
- C. All materials and prestressing material delivered to the job site shall be stored off the ground on planks, supported by 4-inch  $\times$  4-inch timber, which must be covered with polyethylene or sisal-kraft paper to prevent any moisture from coming up from the bottom.
- D. Reels of strand, prestressing threadbars, anchorages, etc., shall be stacked neatly and as compact as possible.
- E. All materials for threadbars and all fabricated threadbars shall be covered with tarpaulins in such a manner that water, rain, moisture and dust are kept away.

#### 1.5 QUALITY ASSURANCE

- A. The tank work shall be performed by a qualified Tank Subcontractor identified by the Contractor in its executed Bid Documents. The Tank Subcontractor shall meet the following requirements to construct the tank:
  - 1. The Tank Subcontractor shall confirm design, furnish and erect AWWA D110 Type I circumferentially strandwrapped prestressed concrete tank of the capacity shown on the Drawings, consisting of a concrete roof, concrete floor and a cast-in-place concrete core wall, post-tensioned vertically with steel threadbars and circum-

ferentially with wrapped strand and protected with several coats of shotcrete and paint. The submitted design shall meet the following criteria:

- a. The specifications and project drawings reflect the mandatory minimum tank design requirements which must be used as a basis for the tank design. The design of the tank shall meet the minimum design requirements per AWWA D110-13 Type I corewall, ACI 350, IBC, Geotechnical Investigation Report by Geo-Engineering & Testing, Inc, dated October 4,2016, as well as, the supplemental requirements specified herein and stated in the general notes for the tank drawings. The roof, columns, column footings and wall footing shall meet the requirements of Section 2.6.5, "Strength Design," and Section 2.6.6, "Serviceability for Normal Sanitary Exposure" of ACI 350, which includes a sanitary and durability coefficient of 1.3 for flexural design of conventionally reinforced concrete and limits the crack control value (Z) to less than 115 k/in.
- b. Seismic design shall be based on the applicable sections of AWWA D110-13, IBC 2012, ACI 350.3, ASCE 7-10, TID 7024 and UFC Criteria. Impulsive and convective forces, as well as, fluid spectral velocity shall be calculated utilizing each code and the maximum value of each component shall be used to calculate the total base shear. The wall bearing pads cannot be considered as contributing to the shear resistance during a seismic event.
- c. The sloshing height shall be calculated using AWWA D110, but need not exceed the fluid displacement calculation when determined using ACI 350.3, TID 7024 or ASCE 7. The effects of the "sloshing wave" shall be accounted for by increasing the freeboard between the normal operating surface and the underside of the roof, or a roof capable of resisting the uplift of such a wave designed. Minimum freeboard height above the design liquid level as shown on the drawings shall be utilized. Any confined portion of the convective (sloshing) mass shall be calculated and applied as an additional impulsive mass.
- d. It is the intent of this specification to have single party responsibility for the construction of the AWWA D110 Type I circumferentially strandwrapped prestressed concrete tank. This single party Tank Subcontractor must meet the requirements as stated in paragraphs 1.6 and 1.7 provided in this specification. The Tank Subcontractor shall not sublet the wall foundations, slabs, cast-in-place walls with embedded PVC waterstops, rubber pads, seismic cables, anchors for prestressing vertical tension units, roof slabs, horizontal machine strand-wrapped prestressing or shotcreting work.

Guam Waterworks Authority Santa Rosa, Sinifa, and Santa Rita Reservoirs REVISION 2 Prestressed Concrete Reservoir Section 033140 - Page 5 B. The approved construction superintendent identified in the executed Bid Documents shall be on Site in responsible charge on a full-time basis during all concrete construction activities associated with the tank.

#### 1.6 WORK BY CONTRACTOR (TANK SUBCONTRACTOR) AND SUPERINTENDENT

- A. 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. Only Tank Subcontractors experienced in the construction of strandwrapped prestressed concrete tanks are qualified to bid on and construct the prestressed concrete tank. Tank Subcontractors shall have successfully designed and completed at least five (5) AWWA D110 Type I circumferentially strand wrapped prestressed concrete tanks.
- B. In order to meet the relevant experience requirements, the five (5) AWWA D110 Type I tanks shall be similar (i.e. freed wall base, poured-in-place corewall, externally machine strand wrapped, etc.) in design to the specified tank. Experience with tanks having fixed wall bases, mild-steel reinforced tank corewalls, shotcrete tank corewalls, precast tank corewalls or tank corewalls incorporating external solid wire wrapping systems or internal stressing systems will not be considered in meeting the required experience requirements. All tanks listed for the Tank Subcontractor's experience requirements must have been built in the Contractor's own name. Experience of personnel associated with the Tank Subcontractor or hired by the Tank Subcontractor will not be considered unless the Tank Subcontractor can demonstrate that the work was contracted and performed directly by the listed Tank Subcontractor in its business name or one of its subsidiaries.
- C. The proposed tank construction superintendent shall be currently employed by the qualified Tank Subcontractor and shall have been the tank construction superintendent on no less than three (3) AWWA D110 Type I circumferentially strandwrapped prestressed concrete tank during the last five (5) years. The qualified tank superintendent shall have been in the direct employment of the qualified Tank Subcontractor for all three (3) of the tanks listed and will be required to be on the project site in responsible charge, full-time, during all tank concrete construction activities.
- D. GWA is desirous of obtaining a prestressed concrete tank which will not develop structural and aesthetic problems. Therefore, as evidenced by these Specifications and Drawings, a strong emphasis on performance has been made to assure that desired details and proven construction methods be utilized to provide the highest quality structure available. For example, the stringent forming and pouring methods, the close-tolerance continuously recorded circumferential prestressing and the automated shotcrete specified are only three of many ways that will help prevent structurally deficient problems from

Prestressed Concrete Reservoir Section 033140 - Page 6 occurring during the service life of the tank. It is imperative that the specified features of these Documents be strictly adhered to and only bids from Tank Subcontractors that have a successful performance record in prestressed concrete tank construction be considered.

- E. A bid will not be considered responsive unless the Tank Subcontractor's, and associated Superintendent's and designer experience requirements have been submitted with the bid.
- F. No stressing system falling under any of the following requirements will be considered unless it has been successfully used on tanks of at least the same diameter, height and capacity. The Tank Subcontractor shall submit with his bid documents demonstrating the compliance with following requirements:
  - 1. The name and location of the owner and the completion dates of five (5) tanks, on which the proposed qualifying "stressing machine" and automated shotcrete equipment meeting the requirements of this specification has been used within the past ten (10) years. All tanks listed for the Tank Subcontractor experience requirements must have been prestressed in the Tank Subcontractor own name (or one of its subsidiaries). Experience of personnel associated with the Tank Subcontractor or hired by the Tank Subcontractor will not be considered unless the Tank Subcontractor can demonstrate that the work was contracted and performed directly by the listed Tank Subcontractor (or one of its subsidiaries).
  - 2. At the time of bid the qualified Tank Subcontractor shall have a minimum of two operable strand-wrapping and automated shotcrete machines meeting these requirements. Machines under construction shall not be considered in meeting the requirement of having two operable strand-wrapping and automated shotcrete machines.
  - 3. Descriptive literature shall be submitted with the bid showing the proposed machinery with the recorders and a typical copy of an actual recording of the applied forces taken from one of the jobs on which such machinery has been used. Any stressing system that will not provide the substantial equivalent of the above requirements will be rejected.
- G. A bid will not be considered responsive unless the above information has been submitted with the bid, which applies to the strand wrapping, the threadbar-stressing and automated shotcrete machines.
- H. Experience gained by the Tank Subcontractor in machine single wire wrapping, internal threadbar systems or external threadbar systems will not be considered in meeting the required experience requirements.

I. The Tank Subcontractor shall have in its employ a design professional engineer with a minimum experience of ten years in the design of AWWA D110 Type I circumferentially strandwrapped prestressed concrete tanks. The design engineer shall have been the engineer of record for a minimum of ten (10) the AWWA D110 Type I circumferentially strand wrapped prestressed concrete tanks in the past ten (10) years. The design engineer shall have designed a minimum of five (5) AWWA D110 Type I circumferentially strand wrapped prestressed concrete tanks in a region with a mapped spectral response acceleration,  $S_s$ , of 1.5g, or greater in the past ten (10) years.

#### 1.7 BID-SUBMITTAL REQUIRED BY TANK SUBCONTRACTOR

- A. As further defined in Paragraph 1.6, the following information shall be required to be submitted with the Tank Subcontractor's bid submittal:
  - 1. The name(s) of the proposed qualified superintendent who will be in direct charge of the tank construction for the full duration of the Contract.
  - 2. A list of at least three (3) tank jobs successfully completed in the past five (5) years by each of the superintendents listed by the Tank Subcontractor, which shall include a tank description, the name and location of the Owner and the Consultant, and the approximate completion date of each tank while directly employed by the Tank Subcontractor. Include shotcrete certification in accordance with ACI 506 for Prestressing Superintendents.
  - 3. The name and address of the Tank Subcontractor, , and a list of at least five(5) AWWA D100 Type I circumferentially strandwrapped prestressed concrete tanks, similar in design to the tank specified here-in, successfully designed and completed by the Tank Subcontractor during the last ten (10) years in its own name.
  - 4. The Tank Subcontractor shall have in its employ a design professional engineer with a minimum experience of ten (10) years in the design of AWWA D110 Type I circumferentially strandwrapped prestressed concrete tanks. The design engineer shall have been the engineer of record for a minimum of ten (10) Type I circumferentially strandwrapped prestressed concrete tanks in the past ten (10) years while employed by the Tank Subcontractor or one of its subsidiaries. The design engineer shall have designed a minimum of five (5) AWWA D110 Type I circumferentially strandwrapped prestressed concrete tanks in a region with a mapped spectral response acceleration, S<sub>s</sub>, of 1.5g or greater in the past ten (10) years. The Tank Subcontractor shall submit with the bid, the experience of the Tank Subcontractor's design engineer including the names and addresses of the prestressed concrete tanks meeting this criteria.

- 5. Descriptive literature of the strandwrapping, the vertical prestressing and the automated shotcrete machinery meeting all of these Specification requirements. Include in such data photographs or prints of the means of recording of both the circumferential and vertical prestressing applications and copies of actual photographs, print-outs or other records of applied wrapping forces (as well as force-elongation diagrams if available) taken from jobs in which the machinery has been used.
- 6. A written statement from the Tank Subcontractor indicating that the Tank Subcontractor has a minimum of two operable strandwrapping and automated shotcrete machines meeting these specifications.
- 7. Failure to submit any of the above with the bid will cause the bid to be considered non-responsive and the bid will be rejected.

#### 1.8 TANK CHARACTERISTICS/DESIGN REQUIREMENTS

- A. Tank design is based on the methods, material and equipment shown on the Drawings and specified in these Specifications. The Specifications and Drawings are based on proven construction techniques that result in successful low-maintenance tank storage performance. The following specific design criteria and salient characteristics are considered essential to the successful construction of the specified AWWA D110 Type I circumferentially strandwrapped prestressed concrete tank.
  - 1. Tank Subcontractor must be experienced in constructing a large quantity of successful tanks, ease of construction, Contractor familiarity with this type of tank construction and reduced inspection costs associated therewith.
  - 2. Adaptability of liners, as specified here-in, to be used under subgrade to prevent water migration.
  - 3. Capability of subgrade to be compacted with heavy equipment.
  - 4. Capability of floor and footing to expand and contract.
  - 5. Satisfactory response of tank under seismic conditions.
  - 6. A "freed" condition between wall and wall-footing by use of neoprene bearing pads.
  - 7. A PVC waterstop between corewall and wall-footing.
  - 8. Properly formed, poured and reinforced poured-in-place walls.

- 9. Concrete floor, walls and roof of the minimum thickness, strength and cement content specified here-in.
- 10. A reduced number of vertical wall joints.
- 11. A PVC waterstop between each vertical wall joint.
- 12. Quantity of vertical prestressing and the type of positive anchoring system as specified here-in.
- 13. Vertical prestressing threadbars consisting of individual threadbars encased in PVC tubing.
- 14. Epoxy pumping of all vertical prestressing threadbars.
- 15. External, continuously strand-wrapped circumferential prestressing providing the desired bond with the shotcrete in addition to the final force specified. (No stressing system based on single wire wrapping, pulling wire through a die or jack-operated, circumferential threadbar or cable systems, based on circumferential movement of the prestressing steel after it is placed in/around the wall, will be allowed.)
- 16. Positive anchoring system of circumferential prestressing to the corewall and spaced as shown on the Drawings.
- 17. Maximum allowable spacing of circumferential prestressing as shown on the Drawings.
- 18. Galvanized circumferential prestressing for long-life performance.
- 19. Continuous and instantaneous recording and correction of all applied prestressing forces.
- 20. A maximum acceptable stress tolerance of  $\pm$  1.5% at any point along the prestressing steel.
- 21. No variation in prestressing forces due to friction losses.
- 22. Automated, wet-mix 10-sack shotcrete applied over a fully sandblasted concrete corewall.
- 23. External paint protection as specified here-in.
- 24. Conventional two-way, flat slab reinforced concrete roof and slope as shown on the Drawings. (No post-tensioned, precast, waffle, dome or other types of roof systems will be allowed.)
- 25. Wall-roof connection as shown on the Drawings.

26. An acceptable tank leakage rate as specified here-in.

#### PART 2 - PRODUCTS

#### 2.1 SEVEN-WIRE STRAND

A. Hot-dipped galvanized seven-wire strand used for circumferential strand wrapping prestressing shall meet the following minimum requirements:

Item	<b>Specifications</b>
Nominal strand diameter	3/8"
Nominal area after galv.(in <sup>2</sup> )	0.089
Nominal weight (lbs/1000 LF)	303
Pitch (strand dia.)	12-16
Tensile strength (lbs) min.	21,400
Yield strength @ 1% extension (lbs) min.	16,000
Elongation in 24-inch at fracture min.	4.5%
Weight of zinc coating (oz/sq ft) min.	0.85

- B. Hot-dipped galvanized seven-wire strand shall be manufactured in accordance with ASTM A-416 prior to galvanizing. Each wire of the strand shall be individually hot-dip galvanized before being stranded.
- C. Single wire prestressing material shall not be utilized in lieu of seven-wire strand prestressing material.

#### 2.2 HIGH-STRENGTH THREADBARS

- A. Deformations of the threadbars shall form a screw-thread suitable for mechanically coupling lengths of threadbar and for positive attachment of anchor assemblies.
- B. Deformations shall conform to ASTM A-722, Type II requirements and shall be uniform such that any length of bar may be cut at any point and the internal threads of a coupling

designated for that size of bar can be freely screwed on the bar. The bars and their deformations shall be hot rolled.

C. Tensile and Physical Properties shall meet the following requirements with bars being manufactured in accordance with ASTM A-722, Type II:

Item	<u>Unit</u>	<b>Specifications</b>
Nominal diameter	inches	1.25
Min. tensile force	kips (min.)	187
Yield force at 0.2% offset	kips (min.)	150
Elong. in 20 bar diameters	% (min.)	4
Nom. cross-sectional area	sq. in.	1.245
Nominal bar weight	lbs/ft.	4.39
Min. wt. of zinc coating	<del>oz./sq. ft.</del>	<del>0.85</del>

D. To provide reduced relaxation, more uniform modulus and reduced residual stress in the critical thread area, only threadbars that are stress relieved after the threads are formed will be accepted. All threadbars shall be proof stressed after stress relieving and threading. Thread bars with quenched or tempered steels will not be permitted and shall have a maximum carbon content of 0.55%. Only manufacturers with at least 5 years of experience (under their current name) in the manufacturing of post-tensioning material will be accepted.

#### 2.3 ANCHORAGES FOR VERTICAL POST-TENSIONED THREADBARS

- A. All post-tensioned prestressing shall be secured at the ends by means of approved permanent anchoring devices, which shall hold the prestressing steel at a force not less than 95% of the guaranteed minimum tensile strength of the prestressing steel.
- B. The load from the vertical prestressing anchoring device shall be distributed to the concrete through steel bearing plates of dimensions and details shown on the Drawings.
- C. All vertical prestressing anchor plate dimensions, all dimensions relating to the conical hole in the top and bottom of the bearing plate (35° cone angle with the vertical), all steel tubing attached to the top bearing plate, and all threadbar spacings shall strictly conform to the details shown on the Drawings.

- D. Fully-threaded anchor connections shall be used at both ends of the vertical prestressing bar, which shall incorporate a spherical-shaped bearing surface to match the conical surface in the bearing plate.
- E. The contact point of the spherical-shaped vertical prestressing bearing surface to conical hole shall be approximately 1/4" to 1/2" below the bearing plate surface.
- F. Wedge anchors shall not be used for permanent anchor hardware.

#### 2.4 TESTING OF PRESTRESSING MATERIAL

- A. Tank Subcontractor shall furnish, at his own expense, Mill test certificates showing the dimensional and physical characteristics of each size, heat or reel of the prestressing steel he has furnished. Additional tests by a local testing laboratory and at Tank Subcontractor's expense will be required for incomplete certificates and prestressing steel of foreign origin.
- B. Tank Subcontractor shall furnish evidence, to the satisfaction of the Engineer, prior to the preparation of shop drawings and installation of vertical threadbars, that the proposed threadbar anchorage system meets the requirements of these specifications. The Engineer may order additional tests to be taken. Should such additional tests not meet the specifications, such expenses shall be paid for by the Tank Subcontractor; otherwise such expenses shall be borne by GWA.
- C. Before any stressing operation may be started, Tank Subcontractor shall calibrate all recording equipment at an approved testing laboratory to the satisfaction of the Engineer.
- D. All continuous force readings for either the vertical or the circumferential prestressing operations shall be developed with electronic (or the substantial equivalent) force (strain gauge method) sensing transducers, all having a maximum non-linearity error of +0.5% and a maximum hysteresis error of +0.5%.

#### 2.5 ANCHOR POCKETS FOR VERTICAL THREADBARS

- A. Anchor pockets for vertical prestressing threadbars shall consist of steel cans, hot-dipped galvanized after cutting (unless shown otherwise on the Drawings) and subsequently welded to the top bearing plate.
- B. Anchor pockets shall be adequately sealed from moisture and concrete intrusion by wooden lids and 2 inch wide plastic adhesive tape. Remove the lid after roof pour and grout void solid after prestressing.

C. Anchor pockets for vertical prestressing threadbars must have adequate provisions for flushing of ducts with water during concrete placement.

#### 2.6 DUCTS FOR VERTICAL THREADBARS

- A. Duct enclosures for vertical prestressing steel shall be standard PVC pipe of size and class specified on the Drawings.
- B. All ducts shall be provided with expandable valves to facilitate the injection of epoxy after prestressing.
- C. All connection details shall be as shown on the Drawings.

#### 2.7 EPOXY GROUT FOR VERTICAL THREADBARS

- A. The vertical threadbar system shall provide complete 2-part epoxy protection of the prestressing steel inside ducting and anchors.
- B. Portland Cement grout will not be accepted.

#### 2.8 PORTLAND CEMENT

A. Portland Cement for the reservoir construction and shotcrete shall meet the requirements set out in Section 033010 of these Specifications.

#### 2.9 SHOTCRETE

- A. Fine aggregates shall meet the requirements set out in Section 033010, Cast-in-Place Concrete in Reservoir Section, of these Specifications.
- B. Well-graded coarse sand shall be used for all shotcrete applications.
- C. Coarse sand shall generally consist of the following gradation, The fineness modulus shall fall between 2.70 and 3.00:

Sieve Size

% Passing by Weight

Guam Waterworks Authority Santa Rosa, Sinifa, and Santa Rita Reservoirs REVISION 2 Prestressed Concrete Reservoir Section 033140 - Page 14

3/8 inch	100
No. 4	95 - 100
No. 8	80 - 100
No. 16	50 - 85
No. 30	25 - 60
No. 50	10 - 30
No. 100	2 - 10

- D. Rebound materials shall not be reused in any form for shotcrete. Rebound is defined as aggregate mixed with cement, which ricochets off the surface during the application of shotcrete because of collision with a harder surface, reinforcement, or other aggregate particles.
- E. Water shall meet the requirements set out in Section 033010, Cast-in-Place Concrete in Reservoir, of these Specifications.
- F. Air-entrainment and admixtures shall meet the requirements specified in Section 033010, Cast-in-Place Concrete in Reservoir, of these Specifications.
- G. Fibrous Shotcrete Reinforcement:
  - 1. All shotcrete, unless otherwise specified here-in, shall be fibrous reinforced. Such material shall consist of 100 percent virgin polypropylene non-fibrillated fibers specifically manufactured for use as concrete/shotcrete secondary reinforcement. The required volume of fibers to be added per cubic yard of shotcrete shall be as specified in Paragraph 2.10.H.
  - 2. Polypropylene fibers will help to provide greater control of cracking from drying shrinkage and thermal expansion/contraction, a reduction of permeability, an increased impact capacity, an improved shatter/abrasion resistance and added toughness of the shotcrete.
  - 3. Fibers shall be manufactured in accordance with ASTM C1116 performance Level I. Fiber length shall be ¼-inch. The amount of the fibers added to the shotcrete used for the finish cover coat shall conform to the manufacturer's recommendations
  - 4. Acceptable polypropylene fibers shall have the following physical characteristics:

- 5. Specific gravity: 0.91
- 6. Fiber length: graded per manufacturer

#### 2.10 SHOTCRETE PROPORTIONING

- A. Each cubic yard of mortar in the ready mix truck or mixer shall consist of 0.1% (1.5 lbs. per cubic yard) polypropylene fibers as specified here-in and a mix ratio of 3 lbs. of moist sand to 1 lb. of Portland cement. Up to 50 oz. of PRO- KRETE-R or POZZOLITH 300R may be added at the option of Contractor during warm weather conditions.
- B. Whenever night temperatures are expected to drop below 35F, shotcrete proportioning shall follow the provisions of ACI 306R, "Cold Weather Concreting".
- C. If the batching procedure requires that smaller volumes of cement and sand be used, the required cement-to-sand ratio shall still be strictly followed.
- D. Additives other than PRO-KRETE-R or POZZOLITH 300R (such as POZZOLITH 300N or others) shall not be used unless specifically approved by the Engineer, after careful consideration of its corrosive influence on prestressing steels.
- E. If used by the shotcreter, the total volumetric air content of the shotcrete before placement shall not exceed 7 percent (plus or minus one percent) as determined by ASTM C-173 or ASTM C-231.
- F. Unless otherwise specified on the Drawings, shotcrete cylinder strengths at 28 days shall be no less than 4,500 psi. Higher shotcrete cylinder strengths shall not permit a reduction in the above specified cement contents. The cement content in the above mix designs may be increased should the specified 28 day strength requirement not be met.
- G. Maximum water-soluble chloride ions present in shotcrete shall not exceed 0.06 percent by weight of the cementitious material in the mix.
- H. The polypropylene fibers and admixtures shall be added to the shotcrete at the time it is batched and in the amounts specified here-in. These additives shall be mixed in strict conformance to the manufacturer's instructions and recommendations for uniform and complete distribution. Each certificate of delivery supplied by the shotcrete supplier shall indicate the additive trade name, manufacturer's name and amount per cubic yard added to each batch of shotcrete.
#### 2.11 SHOTCRETE TESTING

A. Prior to shotcreting operation commencing, Contractor shall test trial mixes or submit test results meeting the requirements of Section 5.3 of ACI 350 for strength and water-soluble chloride ions content in accordance to methods mentioned in Section 033010.

## PART 3 - EXECUTION

## 3.1 CIRCUMFERENTIAL PRESTRESSING EQUIPMENT

- A. The circumferential stressing system shall produce a continuously, electronically (or substantial equivalent) monitored permanent stress or force recording along the full length of the strand as it is being applied. The stress variation in any strand at any point around the circumference should not be greater than  $\pm$  1.5 percent of the ultimate strength of the steel. In addition to this recording, any system which deflects the tensioned strand between the tensioning device and the wall, shall provide a similar continuously monitored stress or force record along the full length of the strand as it is being applied to the wall. These recordings shall show that either before or after deflection, that the stress variation in any strand at any point around the circumference shall not be greater than  $\pm$  1.5 percent of the ultimate strength of the steel. Due to prior instances of force measurement inaccuracies and the inherent problems associated with hand-held stressometers, no manual recorded force readings will be accepted. This requirement shall be strictly followed.
- B. Any wrapping that does not meet the stress tolerances specified and/or cannot meet the requirements of above will not be accepted and will be removed at Contractor's expense. Contractor is responsible for all costs associated with meeting the specified tolerances.
- C. Since intermittent force applications can result in an unequal stress distribution around the wall (due to friction losses), the prestressing system shall be capable of applying a continuous wrapped force at any point around the circumference within the specified tolerances. Circumferential stressing systems based on jack-operated cable or rod-type tendons (such as those placed inside of ducts incorporated in the corewall or placed manually around the exterior of the corewall) will not be allowed.
- D. Since wrapping systems which utilize single solid prestressing material will not provide the desired bond between the prestressing material and the shotcrete and since single solid prestressing material will not provide an adequate safety factor against failure, only machine wrapping systems which utilize seven-wire prestressing strandwrapping will be allowed.

### 3.2 CIRCUMFERENTIAL PRESTRESSING APPLICATION

- A. Wrapped strand shall be anchored to the wall at least at the ends of every coil or reel. Submit anchoring method shop drawings to the Engineer for review.
- B. Permanently anchoring one strand to a previously wrapped strand will not be permitted.
- C. Wrapping strand ends shall be joined by suitable splicing methods that will develop 90% of the full strength of the strand. Submit splicing method shop drawings to the Engineer for review.
- D. Use of different alloys in the splicing material shall not be permitted.
- E. Because prestressing material exposed to excessive temperatures greatly increases the possibility of irrevocable damage, such as steel embrittlement, stress corrosion, or wire splitting, the temperature of the prestressed material during application shall not be allowed to increase by more than fifty degrees during such application. No system that relies on pulling the prestressing material through a die to create a force, will be allowed.
- F. Wrapping may start when the concrete has reached a compressive strength noted on the Drawings; however, under no circumstance shall the compressive stress, exceed 55% of the compressive strength of the concrete attained at that time. The strength of the concrete shall be confirmed by the testing of concrete test cylinders taken from the concrete used for the wall sections.
- G. The clear spacing between any two wrapped strands in the vertical direction shall be at least 1.5 strand diameters or 3/8 inch, whichever is larger. Any wrapped strands not meeting the spacing requirements shall be spread by approved methods or must otherwise be removed.
- H. In the event that gaps between the core wall and the wrapped strand develop that exceed 3/8 inch, wrapping shall be discontinued and the wall shall be built up with shotcrete to provide the proper curvature.
- I. Wrapping over intermediate shotcrete coats or built-up shotcrete areas may commence 12 hours after the shotcrete has been applied or when the shotcrete has reached a compressive strength of 400 psi, whichever is later.

## 3.3 VERTICAL PRESTRESSING EQUIPMENT

- A. The Subcontractor shall provide a continuously, electronically (or substantial equivalent), monitored permanent force elongation record from zero to full force at the final lock-off for all vertical prestressing work.
- B. The ordinate of the permanent recording shall show the elongation in inches and the abscissa shall show the force in pounds or kips.
- C. Manually recorded force and elongation readings will not be accepted.
- D. The vertical threadbar stressing machinery shall have automatic electronic tensioning cut-off devices or equivalent means to ensure that the specified force and elongation is not exceeded at any time during the stressing operation.
- E. The force readings at the stressed bar ends, immediately after lock-off, for any stressing operation, on any thread bar, shall not fluctuate more than + 1.5% of the minimum ultimate strength of the steel from the desired average force setting.
- F. The applied force, immediately after lock-off of the stressing operation on any thread bar, shall be no less than 72% of the minimum ultimate strength of the steel and the applied force before lock-off shall be no greater than 75%.

## 3.4 VERTICAL PRESTRESSING APPLICATION

- A. All permanent anchor hardware shall have a ball-shaped threaded nut that can be screwed down on to a matching cone-shaped bearing surface in the bearing plate after the desired tension on the anchor hardware and/or prestressing steel has been applied.
- B. The number and spacing of the threadbars shown on the Drawings, shall not be altered under any condition.
- C. High-strength threadbars must be used for vertical prestressing.
- D. Vertical thread bar components shall be assembled off the ground and as detailed on the Drawings. All vertical threadbars must be fully assembled before they are installed in the forms.
- E. Particular attention shall be paid to sufficiently taping damaged joint connections and holes in the PVC thread bar ducts.

- F. Anchor plates must be installed at right angles to the threadbar alignment near the anchor. Anchor plates must be installed with long sides, aligned parallel with the wall forms and secured to prevent their rotation while concrete is placed.
- G. The maximum permissible misalignment of anchor plate to threadbar alignment is plus or minus 2.5 degrees.
- H. Vertical prestressing threadbars shall be accurately placed at the locations shown on the Drawings, or as approved by the Engineer, and shall be securely fastened in place to reinforcing steel and form ties to prevent movement during placement of concrete. Placing of vertical tendons shall be done to proper locations, elevations and alignments, with a maximum tolerance of plus or minus 1/4 inch.
- I. Unless indicated otherwise on the Drawings, the minimum concrete cover around steel anchor pockets and bearing plates shall be 1.5 inches.
- J. The vertical clearance between bottom anchor plate and the waterstop at the base of the reservoir walls shall be no less than 2 inches nor more than 4 inches.
- K. All vertical threadbars must be flushed with water from the top immediately upon completion of the concrete vibrating operation. Water shall be introduced through a taped-off hole in the steel lids on the anchor pockets and be permitted to drain through the bottom grout tube. Flushing shall not be accomplished by introducing water through the bottom connection.
- L. Flushing of ducts shall proceed after the pouring and vibrating of concrete around the threadbars ducts has been completed.
- M. Upon completion of the water flushing operation of vertical threadbar ducts, the ducts shall be given a short burst of compressed air from the top only to remove any accumulations of water at the bottom of the ducts.
- N. Cleaning of ducts with air only (not water), or removal of water with air from the bottom connection, will not be permitted.
- O. The ultimate initial prestressing force for vertical threadbars shall not be applied until the concrete compressive strength in the wall shall have reached the specified 28-day strength. Every other threadbar shall be stressed until all thread bars have been stressed to the prescribed level. This will require the prestressor to travel around the reservoir twice.

- P. After the stressed threadbar has been locked-off the threadbars shall be grouted as described below.
- Q. All ducts shall be clean and free of water and deleterious materials that would impair bonding of the grout or interfere with grouting procedures.
- R. Grout injection pipes shall be fitted with positive mechanical shutoff valves, which shall not be removed within the first 24 hours after grouting.
- S. Grouting of threadbar duct shall be started at the lowest grout connection.
- T. Each vertical threadbar duct shall be pumped until the entire nut at the top anchor has been covered. Pea gravel and/or silica sand may be placed (at Tank Subcontractor's option) around the top anchor nut prior to epoxy pumping.
- U. In cold weather, and especially during frosts, special precautions must be taken to avoid the freezing of grout. In the event that the grouting procedure cannot be postponed, the wall temperature must be kept above the freezing point with hot blankets or by other approved means.
- V. Upon completion of the vertical stressing and grouting operation, the inside surface of all the shear cans shall be coated with a 2-part epoxy adhesive. Immediately after the epoxy coating has become tacky, all anchor pocket areas above the anchor nuts shall be drypacked with a 1 cement to 2 sand mortar mix, or alternately, the metal can may filled with concrete aggregates and epoxy.
- W. The drypack surface shall be finished flush with the adjoining concrete surface.

# 3.5 CIRCUMFERENTIAL AND VERTICAL PRESTRESSING OPERATIONS

- A. The maximum initial electronically (or substantial equivalent) recorded steel stress shall not exceed 75 percent of the guaranteed minimum ultimate strength (M.U.S.) of the steel at any time during or after stressing.
- B. Each vertical threadbar in the wall shall be stressed to the values shown on the Drawings before circumferential prestressing starts.
- C. An automatic, continuously electronically (or substantial equivalent) monitored permanent recording of the applied force, at any point on the strand, at any point on and around the reservoir wall, must be made during the entire circumferential prestressing application. All such recordings must be based on a continuous sensing of the applied Guam Waterworks Authority Prestressed Concrete Reservoir Santa Rosa, Sinifa, and Santa Rita Reservoirs Section 033140 - Page 21 REVISION 2

force on the strand between the tensioning drum and the wall when, and as, the strand is being wrapped and laid on the wall.

- D. The force setting on wrapping and vertical threadbar stressing machinery shall be such that the applied forces fall within the specified minimum or maximum stress or force limitations; the force setting shall be corrected immediately when the applied force falls outside the required force tolerance limitations.
- E. In the event that the stressing machinery is incapable of holding the applied forces within the specified stress or force limitations, the Engineer will order, at Contractor's expense, the removal and replacement of such machinery in favor of a different unit capable of maintaining such tolerance requirements.
- F. The loss in stress in post-tensioned prestressing steel due to creep and shrinkage of concrete and sequence stressing has been assumed as 25,000 psi. The final stress is the average initial stress reduced by the stress loss of 25,000 psi.
- G. The final force is the steel section multiplied by the final stress.
- H. The final force for the vertical threadbars shall be no less than the required final force shown on the Drawings.
- I. The initial force for the circumferential wrapped strand shall be no less than the required initial force shown on the plans.
- J. The continuous, electronically-produced force application chart during the wrapping application becomes the property of GWA.
- K. An automatic, continuously electronically (or substantial equivalent) monitored and simultaneously recorded force-elongation reading must be made for each vertical stressing application.
- L. The force-elongation reading must represent the true relationship between the elongation at any given point of the vertical stressing operation and the applied force on the prestressing steel at that same point.
- M. The force-elongation relationship must be constantly maintained from the beginning, starting with the removal of the slack to the point of lock-off and complete release of the force on the vertical prestressing steel after retraction of the stressing piston or equivalent stressing device.

N. All electronically produced force-elongation readings during the vertical threadbar stressing operations become the property of GWA.

### 3.6 SAFETY PRECAUTIONS

- A. Every precaution shall be taken to keep personnel and visitors outside the danger area of breaking strands or bars.
- B. At no time shall anyone stand in the line of the stressed vertical threadbars or stressed strand.
- C. No work shall be performed by anyone, other than the prestressing crew, within 100 feet of the wrapping operation or the application of the vertical threadbars stressing operation.
- D. Where access to the site by unauthorized persons is outside the Contractor's control, while prestressing work is in progress, Contractor shall erect protective fencing to prevent breaking strand from endangering such persons.
- E. No welding to anchor plates is permitted after the threadbars have been assembled. The prestressing steel shall not be used as a "ground" for welding operations.

### 3.7 SAND BLASTING

- A. Exterior surfaces of poured concrete walls shall be sandblasted with #16 silica sand,
   #12/#16 copper slag, or equal, by the dry or wet sandblasting process before
   strandwrapping may be selected. Sandblasting shall not commence before the cpmpletion
   date of the curing period or before all the tie-holes have been drypacked.
- B. The concrete surface shall be heavily pitted leaving no traces of laitance, form-oil and original surface smoothness and surface color.
- C. The minimum sand or copper slag consumption per 100 square feet of surface shall be 150 lbs. for manual application processes and 100lbs. for automated application processes.

## 3.8 SHOTCRETE EQUIPMENT

A. Shotcrete mixing shall be in conformance with the requirements of Section 033010, Castin-Place Concrete in Reservoir, of these Specifications.

Guam Waterworks Authority Santa Rosa, Sinifa, and Santa Rita Reservoirs REVISION 2 Prestressed Concrete Reservoir Section 033140 - Page 23

- B. The delivery equipment shall be of an approved design and size which has given satisfactory results in similar previous work.
- C. The equipment must be capable of discharging mixed materials into the hose under close control and it must be able to deliver a continuous smooth stream of uniformly mixed material at the proper velocity to the discharge nozzle, free from slugs of any kind.
- D. The nozzle shall be of a design and size that will insure a smooth and uninterrupted flow of materials.
- E. Delivery equipment shall be thoroughly cleaned at the end of each shift.
- F. Equipment parts shall be regularly inspected and replaced as required.
- G. The air capacity of the compressor shall be large enough that the minimum amount of air to be available at the nozzle shall be no less than 400 CFM, irrespective of whether or not air from the same air supply is used for other purposes.

# 3.9 SHOTCRETE APPLICATION PROCESS

- A. Prior to application, testing lab shall verify all components, proportions of acceleration, nozzlemen certificate, equipment, and test panel fabrications.
- B. Shotcrete shall be applied under the wet mix process only.
- C. Nozzles shall be mounted on power driven machinery enabling the nozzle to travel parallel to the surface to be sprayed at a uniform linear or bi-directional speed.
- D. The nozzle shall be kept at a uniform constant distance from the surface, always insuring a right angle spray of the material to the surface.
- E. Hand operated nozzles and shotcreting operations dependent on the performance of the nozzleman will not be accepted except where additional shotcrete is needed to correct flat areas or for architectural surface treatments.
- F. Grout materials shall be delivered to the jobsite in ready-mix trucks from approved batching plants. However, job mixing will be accepted provided automatic weigh batch plants are used.

- G. The sand, cement and water shall be premixed before being pumped through a 2" minimum hose by specially designed mortar pumps.
- H. The high velocity impact shall be developed pneumatically by injecting compressed air at the nozzle.
- I. The minimum air capacity to be furnished to the nozzle shall be 400 CFM.

# 3.10 SHOTCRETE PLACING AND FINISHING

- A. Shotcrete shall be applied in a steady, uninterrupted flow. Should the flow become intermittent for any cause, the machine operator shall direct the nozzle away from the work until it again becomes constant, or shut off the flow of materials.
- B. The nozzle shall be held at approximately right angles to the surface and shall be kept at the proper and the same distance from the surface dictated by good practice standards for the type of application, type of nozzle and air pressure employed.
- C. Sufficient time shall be allowed for each layer of shotcrete to set up so it may take the next layer without sagging.
- D. The shotcrete shall be started at the bottom of the wall until all wrapped strand has been covered. Subsequent shotcrete layers may be applied from the top down or from the bottom up at the discretion of the Tank Subcontractor.
- E. While the nozzle travels around the wall, the nozzle shall be raised or lowered at a uniform rate in such a manner that an adequate overlapping of coatings and a uniform finish will develop.
- F. The nozzle shall be spiraled up or down around the reservoir to either the top or the bottom of the wall or to the termination of the intermediate strand layer.
- G. To insure proper penetration around the strand and proper conveyance of the material through the hose, a 5" to 7" slump of the mortar at the pump is recommended.
- H. Prewetting of the wall prior to the shotcrete application shall not be done, even in arid areas. The moisture absorption by earlier applied layers is relied upon to improve the bond and strength of the material and to reduce drying shrinkage of the applied shotcrete.

- I. The application of the shotcrete in the number and thickness of layers specified here-in is mandatory for proper penetration of shotcrete behind prestressing material and to reduce shrinkage due to more uniform in-depth drying of the shotcrete.
- J. Each layer of wrapped prestressing steel shall be covered with shotcrete until a minimum cover of 3/8" over the steel has been obtained.
- K. The final covercoat, to make up for the full thickness of shotcrete over the final strand layer, shall be applied in at least 3 layers of equal thickness.
- L. Each layer of shotcrete shall be completed for the full circumference of the reservoir and substantially the full height of that layer before the next layer of shotcrete may be applied.
- M. All shotcrete coatings shall be built up in layers of approximately 3/8 inch in thickness until the final required thickness has been obtained. The Tank Subcontractor shall demonstrate by a reliable means that the proper thickness of shotcrete has been obtained with each layer applied.
- N. Unless otherwise specified on the Drawings, the minimum shotcrete cover over all wrapped steel shall be 1.5 inches above grade and 2.0 inches below grade.
- O. After the minimum shotcrete cover specified over the wrapped prestressing strand has been completed by the automated shotcrete procedure, and only if such finish requirements are shown on the Drawings, the exterior surface shall be given an acceptable float finish true to line and curvature and to details shown on the Plans.
- P. If a float finish is required on the Drawings, plaster or hand-applied shotcrete may be used to build up and level the surface and to obtain the desired surface finish and projections.
- Q. The finish coat mix (if a smooth float finish is required on the Drawings), shall consist of a minimum of one sack of cement for each 3-1/2 cubic feet of moist plaster sand.
- R. If no finish requirements are shown on the Drawings, it is intended to have a natural original gun finish of the shotcrete cover coat.
- S. Contractor shall take every possible precaution to protect adjacent buildings, concrete surfaces, vehicles, equipment, etc., from being damaged by overshooting shotcrete and by materials carried away by the wind.

- T. Overshot shotcrete and rebound materials deposited on the roof shall be removed before it adheres to the concrete surface.
- U. Contractor shall pay for all damages caused by his operations under this contract.

# 3.11 HAND PLACED SHOTCRETE FOR REPAIRS ONLY

- A. To ensure a high-quality shotcrete, the Tank Subcontractor shall satisfy the Engineer that the nozzleman has had sufficient and acceptable experience in the application of structural shotcrete.
- B. Experience gained on shotcrete pool and ditch construction will not be considered as experience for qualifying the nozzleman, unless approved by the Engineer.
- C. The nozzleman shall be capable of applying thin coats of even and uniform thickness.
- D. The nozzleman's skill shall be tested and approved by the Engineer before he may start any work.

## 3.12 RESTRICTIONS ON SHOTCRETE OPERATION

- A. Shotcrete shall not be applied under such strong wind conditions that a considerable amount of cement and moisture will be removed by the wind from the mortar spray between the nozzle and the surface on which the shotcrete is applied.
- B. Shotcrete may be applied in cold weather provided the surfaces are not frozen.
- C. The temperature during the day must be expected to rise to at least 40°F and the night temperature of the first night after the shotcrete application must not be expected to drop below 27°F.
- D. The use of Type 3 Portland cement is required (when readily available) in the event shotcrete is applied at temperatures below 40°F.
- E. The Tank Subcontractor may apply shotcrete under those conditions solely at his own risk.
- F. Whenever rain or frost has damaged shotcrete which has not had a chance to set up, such shotcrete must be removed and replaced.

G. Tank Subcontractor shall consult with the Engineer to determine whether or not he will accept the shotcrete damaged by rain or frost before applying any new layers of shotcrete.

### 3.13 SHOTCRETE WATERCURING

- A. Intermediate layers of shotcrete shall be kept damp by hand curing or other means no sooner than 12 hours after the shotcrete has been applied.
- B. This watercuring is not required should additional shotcrete be applied on the entire wall surface within the following 12 hours.
- C. An indiscriminate use of continuous watercure for intermediate layers should be avoided.
- D. Complete shotcrete surfaces, which do not receive any additional coatings, shall be watercured for a period of at least seven (7) days by encapsulating the shotcrete inside the plastic sheeting. Such plastic sheeting shall be lapped and sealed as necessary to properly cure the shotcrete. Membrane curing methods utilizing curing compounds or wax-based residuals will not be permitted.
- E. Wall coatings, specified in the Protective Coatings Section, shall be applied no later than five (5) days after completion of the curing. If conditions make it impossible to apply coatings within the five (5) day period, or if no coatings are required, shotcrete shall be membrane cured for a period of ten (10) days instead of the seven (7) days specified here-in.

## 3.14 TESTING AND DISINFECTION

- A. General
  - 1. Water for testing and disinfecting shall be furnished by GWA; however, the Contractor shall convey the water from GWA-designated source to the points of use.
  - 2. All hydraulic structures and appurtenant piping shall be tested; those for potable water shall also be disinfected by chlorination. All chlorinating and testing operations shall be performed in the presence of the Contracting Officer. Testing shall be in accordance with the requirements of ACI 350.1-10 as modified herein.
  - 3. Testing and disinfection operation shall be combined.

- 4. Disinfection operations shall be scheduled as late as possible during the Contract Time to maximize the degree of sterility of the facilities at the time the Work is accepted by GWA. Bacteriological testing shall be performed by a certified testing laboratory acceptable to GWA. Results of the bacteriological testing shall be satisfactory to Guam EPA or other appropriate regulatory agency.
- 5. Reservoir structure and appurtenant pressure piping shall be tested for leakage prior to backfill placement.
- 6. Any release of chlorinated water shall comply with federal, Government of Guam, and local regulation and the permits for the project. Chlorine in excessive amounts shall be treated in accordance with permit requirements and ANSI/AWWA C655 before discharge. Dechlorination agents may be sodium bisulfate, sodium sulfite, or sodium thiosulfate.
- 7. The structure will not be accepted until the leakage test is passed and all visible leakage repaired. The retesting shall again be combined with disinfection, exclusive of the spraying operation.
- 8. The reservoir shall not be backfilled and exterior coating shall not be applied until and unless GWA has accepted the tests. Once authorized to backfill, the reservoir shall be at least half full when the reservoir is backfilled. The backfill shall be placed equally around the reservoir as it is compacted, it shall not be piled against one portion of the perimeter unevenly. No track driven equipment shall be within 5 feet of the reservoir wall during backfilling operations without the approval of GWA.
- B. Preliminary Cleaning and Flushing
  - 1. Prior to testing, all hydraulic structures shall be cleaned by thoroughly hosing down all surfaces with a high pressure hose and nozzle of sufficient size to deliver a minimum flow of 50 gpm. All water, dirt, and foreign material accumulated in this cleaning operation shall be discharged from the structure or otherwise removed.
- C. Hydrostatic Testing
  - 1. General: Testing shall be performed prior to backfilling. Testing shall not be performed sooner than 28 days or until the hydraulic structure's concrete has attained its specified compressive strength, whichever is longer, after all portions of structure walls and associated roof systems have been completed.

- 2. Leakage Test and Repairs: After the structure has been filled, the leakage test shall be performed as follows:
  - a. Close all valves and securely seal all openings and penetrations to prevent loss of water during the test.
  - b. Reservoir drain line from the ring drain shall then be examined for evidence of leaks.
  - c. Inspect the structure for visible leakage. Locations with any visible leakage, as evidenced by liquid droplets, flowing water, or moist areas on the outside surface which could have originated from inside the structure, will be considered defective and shall be repaired before testing proceeds. All penetrations, pipes, conduits, and outlets shall be monitored before and during the test determine the water tightness of these appurtenances. Leakage at these appurtenances shall be repaired prior to test measurements. No allowance will be given in test measurements for uncorrected known points of leakage.
  - d. The hydrostatic test period shall be five (5) days.
  - e. The maximum initial filling of the new structure shall not exceed 3.0 feet of depth per hour.
  - f. The test shall consist of filling the hydraulic structure with water to the following applicable test level, whichever is higher: The maximum operating water surface indicated on the Drawings, 4.0 inches below the crest of a control weir if the maximum water level will be controlled by the weir, or 4.0 inches below the overflow elevation.
  - g. The hydraulic structure shall be inspected daily for damp spots, seepage and leakage during the hydrostatic test period. The limits of flowing water or damp spots, if observed during daily inspections, shall be marked and recorded for later repair.
- D. Tightness Criteria: The hydraulic structure shall be considered to have passed if both of the following criteria are met after allowance is made for evaporation loss and/or precipitation gain:
  - 1. No visible leakage, as defined in Paragraph 3.14.E.1 during the hydrostatic test period.

- 2. Allowable leakage (Unlined concrete hydraulic structure): The net water loss measured at the end of the hydrostatic test period, as determined by averaging the adjusted results at the two measurement locations as defined in Paragraph 3.14.E.4, is equal to or less than 0.050 percent loss of the water test volume per day in average over the hydrostatic test period.
- E. Leakage Test and Repairs: After the hydraulic structure has been filled, the water loss leakage test shall be performed as follows:
  - 1. Inspection of the hydraulic structure for visible leakage:
    - a. Locations with any visible leakage will be considered defective and shall be repaired before the testing period begins. Visible leakage is defined as liquid droplets, flowing water, or damp spots on the exterior surfaces, which only could have originated from the interior. Damp spots are defined as spots where moisture can be picked up on a dry hand from the exterior surface.
    - b. Measurable flow, damp spots, or standing or flowing water on the wall footing are not permissible and shall be corrected.
    - c. The source of water movement through the wall shall be located and permanently sealed in accordance with the requirements of ANSI/AWWA D110 Section 5.14 – Repairs. Leakage through the wallbase joint or footing shall likewise be corrected.
  - 2. Measurement of evaporation loss and/or precipitation gain:
    - a. Provide a clear open-top calibrated rigid plastic container, no less than 18-inch in diameter and in depth and partly fill the container with water.
    - b. Allow the plastic container to float in the hydraulic structure and hold in position at each measurement location but away from the walls and structure members passing overhead, such as beams, girder, or pipes.
    - c. Take measurement of the depth of water in container whenever the water level in the hydraulic structure is measured.
  - 3. Measurement of water temperature:

- a. Water temperature readings shall be made a depth 18 inches below the water surface.
- b. Water temperature readings shall be recorded whenever the water level in the hydraulic structure is measured.
- 4. Measurement of water level:
  - a. Water level measurements shall be made at two locations that are approximately 180° apart if the structure is circular or at opposite ends if the structure is non-circular.
  - An initial water level reading shall be made after a 72-hour absorption and stabilization period following the completion of the filling operation. Readings shall be recorded at 24-hour intervals during the hydrostatic test period. At the end of the hydrostatic test period, the final reading of the water level shall be made.
- 5. If intermediate readings or observed leakage indicate that the allowable leakage will be exceeded, the test may be terminated before the end of the hydrostatic test period and appropriate action shall be taken to correct the problem before commencing a new hydrostatic test period.
- 6. If the hydraulic structure fails the test, the Contractor may at its option repeat the test or empty the structure as acceptable to the Contracting Officer and examine the interior for evidence of any cracking or other conditions that might be responsible for the leakage.
- 7. Any evidence of leakage shall be repaired in accordance with the requirements of ANSI/AWWA D110 Section 5.14 Repairs. Each source of leakage shall be repaired on the water-holding side unless otherwise approved by the Contracting Officer.
- 8. Following these operations, the Contractor shall again test the structure. The structure will not be accepted until the water loss leakage test is passed and all visible leakage repaired. In the case of a reservoir, the retesting shall again be combined with disinfection, exclusive of the spraying operation.
- F. Testing of Appurtenant Piping

- 1. Piping appurtenant to hydraulic structures shall be tested in accordance with applicable requirements in Section 331300 Disinfecting of Water Utility Distribution.
- G. Disinfecting of Reservoir Structure and Appurtenant Pipelines
  - 1. Structures which store or convey potable water shall be disinfected by chlorination in accordance with the requirements of ANSI/AWWA C652, using a combination of chlorination Methods 2 and 3 as modified herein.
  - 2. Chlorination: A strong chlorine solution of approximately 200 mg/L shall be sprayed on all interior surfaces of the structure. Following this, the structure shall be partially filled with water to a depth of approximately two (2) feet. During the partial filling operation, a chlorine-water mixture shall be injected by means of a solution-feed chlorinating device in such a way as to give a uniform chlorine concentration during the entire filling operation. The point of application shall be such that the chlorine solution will mix readily with inflowing water. The dosage applied to the water shall be sufficient to provide a chlorine residual of at least 40 mg/L upon completion of the partial filling operation. Precautions shall be taken to prevent the strong chlorine solution from flowing back into the lines supplying the water. After the partial filling has been completed, sufficient water shall be drained from the lower ends of appurtenant piping to ensure filling the pipe with the heavily chlorinated water.
  - 3. Retention Period: Chlorinated water shall be retained in the partially filled structure and appurtenant piping for at least 24 hours. Each valve shall be operated at least once from closed to full open to closed while the lines are filled with the heavily chlorinated water. After the chlorine-treated water has been retained for the required time, the free chlorine residual in the structure and appurtenant piping shall be at least 20 mg/L. If testing does not demonstrate a residual of 20 mg/L or greater, the disinfection procedure above shall be repeated.
  - 4. Final filling of the structure: After the free chlorine residual has been verified to satisfy the 20 mg/L requirement, the water level in the structure shall be raised to its final elevation by addition of potable water. Some heavily chlorinated water shall be treated and released, if necessary, before final filling with potable water, such that the free chlorine residual after filling will be between 1.0 and 2.0 mg/L. After the structure has been filled, the strength of the chlorinated water shall be determined. If the free chlorine residual is less than 1.0 mg/L, and additional dosage of chlorine shall be applied to the water. If the free chlorine residual is greater than 2.0 mg/L, the structure shall be partially emptied and

Guam Waterworks Authority Santa Rosa, Sinifa, and Santa Rita Reservoirs REVISION 2 Prestressed Concrete Reservoir Section 033140 - Page 33 additional potable water added. In no case shall water be released prior to the expiration of the required retention period.

- H. Bacteriological Sampling and Testing
  - 1. Disinfected water storage facilities shall be sampled and test by a certified bacteriological laboratory approved by the Contracting Officer. The disinfection shall be accepted if samples taken for the final bacteriological test conform to AWWA Standard C-651 and are found to be satisfactory.
- I. Connections to Existing System
  - 1. Where connections are to be made to an existing potable water system, the interior surfaces of all pipe and fittings used in making the connections shall be swabbed or sprayed with a one percent hypochlorite solution before installation. Thorough flushing shall be started as soon as the connection is completed and shall be continued until all discolored water is eliminated.
- J. Contractor shall purchase and surrender the following materials and equipment to GWA:
  - 1. One (1) pail of sodium sulfite tablets, minimum of 45-lbs. Tablets shall be D-Chlor<sup>TM</sup> Dechlorination Tablets, or approved equal.
  - 2. Two (2) floating dispensers capable of holding 3-inch diameter tablets. Floating dispenser shall be HDX 62155, or approved equal.
  - 3. GWA shall provide storage location for dechlorination materials and equipment mentioned above.

END OF SECTION 033140

## SECTION 099000 - PAINTING AND COATING

## PART 1 - GENERAL

### 1.1 SUMMARY

- A. Section Includes: Surface preparation and field application of paints and protective coatings, complete and in place, in accordance with the Contract Documents.
- B. The following surfaces shall not be protective coated:
  - 1. Concrete, unless required by items on the concrete coating schedule below or the Drawings.
  - 2. Stainless steel
  - 3. Machined surfaces
  - 4. Grease fittings
  - 5. Glass
  - 6. Equipment nameplates
  - 7. Brass and copper tubing above grade
  - 8. Platform gratings, stair treads, door thresholds, and other walk surfaces, unless specifically indicated to be coated.
  - 9. Buried pipe, unless specifically required in the piping specification.

Surfaces not intended to be painted shall be removed, masked, or otherwise protected. Drop cloths shall be provided to prevent paint materials from falling on or marring adjacent surfaces. Working parts of mechanical and electrical equipment shall be protected from damage during surface preparation and painting process. All masking materials shall be completely removed, and surfaces cleaned at completion of the painting operation.

- C. The coating system schedules summarize the surfaces to be coated, the required surface preparation, and the coating systems to be applied. Coating notes on the Drawings are used to show or extend the limits of coating schedules, to show exceptions to the schedules, or to clarify or show details for application of the coating systems.
- D. Where protective coatings are to be performed by a painting applicator, the painting applicator shall possess a valid Territory of Guam license as required for performance of the painting and coating Work called for in this specification and shall provide 5 references, which demonstrate that the painting applicator has previous successful experience with the indicated or comparable coating systems. Include the name, address, and the telephone number for the owner of each installation for which the painting subcontractor provided the protective coating.
- E. Related Requirements:
  - 1. Section 055000 Metal Fabrications: Shop-primed items.
  - 2. Section 099654 Reservoir Coating.
  - 3. Section 260553 Identification for Electrical Systems: Stenciling, color-coding, and identification banding.

4. Section 270553 - Identification for Communications Systems: Stenciling, color-coding, and identification banding.

### 1.2 DEFINITIONS

- A. Terms used in this Section:
  - 1. The term "paint," "coatings," or "finishes" as used herein, shall include surface treatments, emulsions, enamels, paints, epoxy resins, and all other protective coatings, excepting galvanizing or anodizing, whether used as a pretreatment, primer, intermediate coat, or finish coat. The terms paint and coating are used interchangeably.
  - 2. The term "mils" means thousandth of an inch (0.001 inch).
  - 3. The term "Coverage" means total minimum dry film thickness, mils or square feet per gallon.
  - 4. The term "DFT", minimum dry film thickness, means the minimum film thickness of the fully cured, dry paint or coating without any negative tolerance, mils.
  - 5. The term "DFTPC" means minimum dry film thickness per coat, mils/coat.
  - 6. The term "SFPG" means square feet per gallon.
  - 7. The term "SFPGPC" means square feet per gallon per coat.
  - 8. The term "hydraulic structure" means environmental engineering structures for the containment, treatment, or transmission of water, wastewater, other fluids, or gases, which may include steel or concrete tanks, basins, reservoirs, channels or conduits.

#### 1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.
- B. Commercial Standards
  - 1. American Association of State Highway and Transportation Officials (AASHTO)

	AASHTO T259	Standard Method of Test for Resistance of Concrete to Chloride Ion Penetration			
2.	American Conference of G	overnmental Industrial Hygienists (ACGIH)			
	ACGIH 0100Doc	Documentation of the Threshold Limit Values and Biological Exposure Indices			
3.	ASTM International (AST)	M)			
	ASTM C793	Standard Test Method for Effects of Laboratory Accelerate Weathering on Elastomeric Joint Sealants			
	ASTM D751	Standard Test Methods for Coated Fabrics			
	ASTM E96	Standard Test Methods for Water Vapor Transmission of Materials			

ASTM E514	Standard Test Method for Water Penetration and Leakage through Masonry	
ASTM D16	Standard Terminology for Paint, Related Coatings, Materials, and Applications	
ASTM D4442	Standard Test Methods for Direct Moisture Content Meas- urement of Wood and Wood-Base Materials	
ASTM E84	Standard Test Method for Surface Burning Characteristics of Building Materials	
American Water Works As	sociation (AWWA)	
ANSI/AWWA C105	Polyethylene Encasement for Ductile-Iron Pipe Systems	
ANSI/AWWA C213	Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines	
National Sanitation Founda	tion (NSF)	
ANSI/NSF 61	Drinking Water System Components Health Effects	
Society for Protective Coati	ings (SSPC)	
SSPC-PA 1	Paint Application Specification No. 1	
SSPC PA Guide 3	A Guide to Safety in Paint Application	
SSPC-SP 1	Solvent Cleaning	
SSPC-SP 2	Hand Tool Cleaning	
SSPC-SP 3	Power Tool Cleaning	
SSPC-SP 5/NACE No. 1	White Metal Blast Cleaning	
SSPC-SP 6/NACE No. 3	Commercial Blast Cleaning	
SSPC-SP 7/NACE No. 4	Brush-Off Blast Cleaning	
SSPC-SP 10/NACE No. 2	Near-White Blast Cleaning	
SSPC-SP 13/NACE No. 6	Surface Preparation of Concrete	
SSPC-SP 16	Brush-Off Blast Cleaning	
SSPC-VIS 1	Guide and Reference Photographs for Steel Surfaces Pre- pared by Dry Abrasive Blast Cleaning	

4.

5.

6.

SSPC-VIS 3 Guide and Reference Photographs for Steel Surfaces Prepared by Hand and Power Tool Cleaning

### 1.4 PREINSTALLATION MEETINGS

A. Section 013000 - Administrative Requirements: Requirements for preinstallation meeting.

### 1.5 SEQUENCING

- A. Section 011000 Summary: Requirements for sequencing.
- B. Do not apply finish coats until paintable sealant is applied.

### 1.6 SUBMITTALS

- A. Section 013300 Submittal Procedures: Requirements for submittals.
- B. Submittals shall include the following information and be submitted at least 30 days prior to protective coating Work:
  - 1. Coating Materials List: A coating materials list showing the manufacturer and the coating number, keyed to the coating systems herein. The list shall be submitted prior to or at the time of submittal of samples.
  - 2. Paint Manufacturer's Information: For each coating system to be used, the following data:
    - a. Paint manufacturer's product data sheet (PDS) for each product proposed, including statements on the suitability of the material for the intended use.
    - b. Technical and performance information that demonstrates compliance with the system performance and material requirements.
    - c. Paint manufacturer's instructions and recommendations on surface preparation and application.
    - d. Colors available for each product (where applicable).
    - e. Compatibility of shop and field applied coatings (where applicable).
    - f. Safety Data Sheet (SDS) for each product used.
    - g. Minimum and maximum recommended dry-film thicknesses per coat for prime, intermediate, and finish coats.
    - h. Recommended thinners.
- C. Samples
  - 1. Two sets of color samples to match each color selected by the Contracting Officer from the manufacturer's standard color sheets. If custom mixed colors are indicated, the color samples shall be made using color formulations prepared to match the color samples furnished by the Contracting Officer. The color formula shall be shown on the back of each color sample.
  - 2. One 5-pound sample of each abrasive proposed to be used for surface preparation for submerged and severe service coating systems.

- 3. One set of 4-inch by 4-inch steel panels for each grade of sandblast specified in this Section, prepared to specified requirements prior to start of surface preparation.
- 4. Samples of all paint, finishes, and other coating materials shall be submitted on 8-inch by 10-inch sheet metal. Each sheet shall be completely coated over its entire surface with one protective coating material, type, and color.
- 1.7 Regulatory Requirements
  - A. In addition to requirements specified elsewhere for environmental protection, the coating materials shall conform to the restrictions of the local air pollution control agency and regional jurisdiction. The Contractor shall notify Contracting Officer of any coatings specified herein which fails to conform.
  - B. Lead Content: Coating materials shall have a lead content no more than 0.06 percent by weight of nonvolatile content.
  - C. Chromate Content: Coating materials shall not contain zinc-chromate or strontium-chromate.
  - D. Asbestos Content: Coating materials shall not contain asbestos.
  - E. Mercury Content: Coating materials shall not contain mercury or mercury compounds.
  - F. Silica: Abrasive blast media shall not contain free crystalline silica.
  - G. **Human Carcinogens:** Coating materials shall not contain ACGIH 0100Doc confirmed human carcinogens (A1) or suspected human carcinogens (A2).
  - H. OSHA Personnel protection during all phases of work, including exposure to airborne solvents, dust, and lead.
  - I. NSF/ANSI 61 Coating systems for surfaces in contact with potable water shall be NSF/ANSI Standard 61 approved.

## 1.8 SAFETY METHODS USED DURING COATING APPLICATION

- A. The Contractor shall apply coating materials using safety methods in compliance with the requirements of SSPC-PA Guide 3.
- B. Ventilation, electrical grounding, and care in handling coatings, paints, solvents and equipment are important safety precautions during coating and painting projects. Conform with safety requirements set forth by regulatory agencies applicable to the construction industry and manufacturer's printed instructions and material safety data sheets. Personal protective life saving equipment for persons working in or about the project site must be provided and the use of required.

Where ventilation is used to control hazardous exposure, all equipment will be explosion-proof. Reduce the concentration of air contaminant to the degree a hazard does not exist by exhausting air, vapors, etc. from the confined space. Air circulation and exhausting of solvent vapors will be continued until coatings have fully cured. Forced air reduction during blast cleaning and coating application operations is mandatory.

- C. The Contractor's safety officer shall demonstrate to the Owner, or his representative, that respirators used on the project meet OSHA 29 CFR 1910.134, Respiratory Protection for Workers, and comply with the coating manufacturer's Safety and Data Sheets (SDS) for respiratory protection. Whenever in doubt, fresh air masks shall be used in conjunction with a gas monitor to periodically measure LEL.
- D. A "tank-watch" safety person who is trained in the use of a gas monitor for measuring LEL and oxygen levels during tank and confined space coating operations must be provided.
- E. During abrasive blasting operations, nozzlemen shall wear U.S. Bureau of Mines approved air-supplied helmets and all other persons who are exposed to blasting dust will wear approved filter-type respirators and safety goggles. When coatings are applied in confined areas, all persons exposed to toxic vapors shall wear approved air-supplied masks. Barrier creams shall be used on any exposed areas of the skin.
- F. Illumination: Provide spark-proof artificial lighting for all work in confined spaces. Guard light bulbs to prevent breakage. Lighting fixtures and flexible cords must comply with the requirements of NFPA 70 "National Electric Code" for the atmosphere in which they will be used.

### 1.9 SPECIAL CORRECTION OF DEFECTS REQUIREMENT

A. **Warranty Inspection:** A warranty inspection may be conducted during the eleventh month following completion of all coating and painting Work. The Contractor and a representative of the paint manufacturer shall attend this inspection. All defective Work shall be repaired in accordance with these specifications and to the satisfaction of GWA. GWA may, by written notice to the Contractor, reschedule the warranty inspection to another date within the one-year correction period, or may cancel the warranty inspection altogether. If a warranty inspection is not held, the Contractor is not relieved of its responsibilities under the Contract Documents.

## 1.10 CLOSEOUT SUBMITTALS

- A. Section 017000 Execution and Closeout Requirements: Requirements for submittals.
- B. Operation and Maintenance Data: Submit information on cleaning, touchup, and repair of painted and coated surfaces.

## PART 2 - PRODUCTS

#### 2.1 GENERAL

- A. **Suitability:** The Contractor shall use suitable coating materials as recommended by the manufacturer. Materials shall comply with Volatile Organic Compound (VOC) limits applicable at the Site.
- B. **Material Sources:** Where manufacturers and product numbers are listed, it is to show the type and quality of coatings that are required. If a named product does not comply with VOC limits in effect at the time of bid opening, that product will not be accepted, and the Contractor shall propose a substitution product of equal quality that does comply. Unless indicated otherwise,

proposed substitute materials will be considered as indicated above. Coating materials shall be materials that have a record of satisfactory performance for essentially identical service conditions.

- C. **Compatibility:** In any coating system only compatible materials from a single manufacturer shall be used in the Work. Particular attention shall be directed to compatibility of primers and finish coats. If necessary, a barrier coat shall be applied between existing prime coat and subsequent field coats to ensure compatibility.
- D. **Containers:** Coating materials shall be sealed in containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, and name of manufacturer, all of which shall be plainly legible at the time of use.
- E. **Colors:** All colors and shades of colors of all coats of paint shall be as indicated or selected by the Contracting Officer. Each coat shall be of a slightly different shade, to facilitate inspection of surface coverage of each coat. Finish colors shall be as selected from the manufacturer's standard color samples by the Contracting Officer
- F. Substitute or "or Approved Equivalent" Products
  - 1. To establish equality, the Contractor shall furnish satisfactory documentation from the manufacturer of the proposed substitute or "or Approved Equivalent" product that the material meets the indicated requirements and is equivalent or better in the following properties:
    - a. Quality
    - b. Durability
    - c. Resistance to abrasion and physical damage
    - d. Life expectancy
    - e. Ability to recoat in future
    - f. Solids content by volume
    - g. Dry film thickness per coat
    - h. Compatibility with other coatings
    - i. Suitability for the intended service
    - j. Resistance to chemical attack
    - k. Temperature limitations in service and during application
    - 1. Type and quality of recommended undercoats and topcoats
    - m. Ease of application
    - n. Ease of repairing damaged areas
    - o. Stability of colors
  - 2. Protective coating materials shall be standard products produced by recognized manufacturers who are regularly engaged in production of such materials for essentially identical service conditions. Where requested, the Contractor shall provide the Contracting Officer with the names of not less than 10 successful applications of the proposed manufacturer's products that comply with these requirements.
  - 3. If a proposed substitution requires changes in the Work, the Contractor shall bear all such costs involved as part of the Work

### 2.2 PAINTS AND COATINGS

- A. System 1 Not Used.
- B. System 2 Not Used.
- C. System 3 Not Used.
- D. System 4 Aliphatic Polyurethane: Two component aliphatic acrylic polyurethane coating material shall provide superior color and gloss retention, resistance to splash from acid and alkaline chemicals, resistance to chemical fumes and severe weathering and with a minimum solids content of 69 percent by volume. Primer shall be a rust inhibitive two component epoxy coating with a minimum solids content of 67 percent by volume.
  - Coat VOC Manufacturer, or Approved Coverage Equivalent Content (mils) (g/L max.) 1. Primary Coat 4 to 6 250 1. PPG Amerlock 400/2 DFTPC 2. Carboline 893 3. International Devoe Devran 224V 4. Tnemec Series 66HS Epoxoline 1. PPG Amershield VOC 2. Finish Coat 2 to 3 250 DFTPC 2. Carboline 134 VOC 3. International Devthane 379H 4. Tnemec Series 1095 Endura-Shield 3. Total System 6 to 9 DFT
  - 1. Paint Schedule:

- 2. More than one finish coat shall be applied as necessary to produce a finish with uniform color and texture.
- E. System 5 Inorganic Zinc/Polyurethane: The inorganic zinc primer shall be a water or solvent based, self-curing, zinc silicate two-component inorganic coating which contains at least 83 percent of metallic zinc by weight in the dried film and is recommended by the paint manufacturer as a primer for this system. The intermediate coat shall be a high-build two component epoxy with a solids content of at least 67 percent by volume. Finish coats shall be a 2-component aliphatic acrylic polyurethane or aliphatic polyurethane coating material that provides superior color and gloss retention, resistance to chemical fumes and severe weathering, and a minimum solids content of 70 percent by volume.
  - 1. Paint Schedule:

	Coat	Coverage	VOC Content	Manufacturer, or
		-	(g/L max.)	Approved Equivalent
1.	Primary Coat	3 to 4 mils	250	1. <b>PPG Amerlock 400/2</b>
		DFTPC		2. Carbozinc 11WB
				3. International Devoe
				Cathacoat 313
				4. Tnemec Series 90-97
				Tneme-Zinc
2.	Intermediate	5 to 8 DFTPC	250	1. <b>PPG Amershield VOC</b>
	Coat			2. Carboguard 890 or 891
				VOC
				3. International Devoe
				Devran 224V
				4. Tnemec Series 66HS
				Epoxoline
3.	Finish Coat	2 to 3 DFTPC	250	1. PPG Amershield VOC
				2. Carboline 134 VOC
				3. International Devoe Dev-
				thane 379H
				4. Tnemec Series 1095 En-
				dura-Shield
4.	Total System	10 to 15 DFT		3

- 2. Intermediate coat shall be applied in excess of 4 mils DFT or in more than one coat as necessary to completely cover the inorganic zinc primer and prevent application bubbling of the polyurethane finish coat.
- 3. More than one finish coat shall be applied as necessary to produce a finish with uniform color and texture. If the inorganic zinc primer is used as a pre-construction or shop applied primer, all damaged and uncoated areas shall be spot abrasive blasted and coated after construction using the indicated material.
- F. System 6 Not Used.
- G. System 7 Acrylic Latex: Single component, water based acrylic latex with a fungicide additive shall have a minimum solids content of 35 percent by volume. Prime coat shall be as recommended by manufacturer. The coating material shall be available in the ANSI safety colors.
  - 1. Paint Schedule:

	Coat	Coverage	VOC Content (g/L max.)	Manufacturer, or Approved Equivalent
1.	Primary Coat	2 DFTPC	180	• Per manufacturer's recommendations
2.	Finish Coat	2 or more coats, 2 to 3 DFTPC	180	<ol> <li>PPG Amercoat 220</li> <li>Carboline 3359</li> <li>Tnemec Series 1029 En- duratone</li> <li>International Devoe Devcryl 1448</li> </ol>
3.	Total System	8 DFT		

- H. **System 8 Epoxy, Equipment:** Two-component, rust inhibitive polyamide cured epoxy coating material shall provide a re-coatable finish available in a wide selection of colors. The coating material shall have a minimum solids content of 67 percent by volume and be resistant to service conditions of condensing moisture, splash and spillage of lubricating oils, and frequent washdown and cleaning.
  - 1. Paint Schedule:

	Coat	Coverage	VOC Content (g/L max.)	Manufacturer, or Approved Equivalent
1.	Primary Coat	4 to 6 DFTPC	250	<ol> <li>PPG Amerlock 2/400</li> <li>Devoe Bar-Rust 231</li> <li>Tnemec Series 66HS Epoxo- line</li> <li>Carboguard 890</li> </ol>
2.	Finish Coat	4 to 6 DFTPC	250	<ol> <li>PPG Amerlock 2/400</li> <li>Devran 224V</li> <li>Tnemec Series 66HS Epoxo- line</li> <li>Carboguard 890</li> </ol>
3.	Total System	8 to 12 DFT		

I. System 9 – Inorganic or Organic Zinc/Epoxy, Equipment: The inorganic or organic zinc primer shall be a water or solvent based, self curing, zinc silicate, two-component inorganic coating that contains at least 83 percent of metallic zinc by weight in the dried film and is recommended by the paint manufacturer as a primer for this system. The finish coats shall be a polyamide cured epoxy material with a minimum solids content of at least 75 percent by volume, and available in a large selection of colors.

1. Paint Schedule:

Coat	Coverage	VOC Content (g/L max.)	Manufacturer, or Approved Equivalent
1. Primary Coat	3 to 5 DFTPC	0	<ol> <li>PPG Dimetcote 21-5</li> <li>Carboline Carbozinc 11 WB</li> <li>International Devoe Cathacote 304L</li> <li>Tnemec Series 90-97 Tneme-Zinc</li> </ol>
2. Finish Coat	2 or more coats, 4 to 6 DFTPC	250	<ol> <li>PPG Amerlock 400/2</li> <li>Carboline Carboguard 890</li> <li>Devran 224V</li> <li>Tnemec Series 66HS Epoxo- line</li> </ol>
3. Total System	11 to 17 DFT		

- J. System 10 Not Used.
- K. System 11 Aliphatic Polyurethane, Concrete: Two component aliphatic polyurethane coating material shall provide superior color and gloss retention, resistance to splash from acid and alkaline chemicals, resistance to chemical fumes and severe weathering, and contain a minimum solids content of 71 percent by volume. Filler-sealer compound shall be a two- or three-component epoxy material used to provide a smooth surface for the epoxy intermediate coat with a minimum solids content of 68 percent by volume. The filler-sealer is applied to the entire concrete surface and worked into the concrete surface with a wide blade putty knife or squeegee. The intermediate coat shall be a high-build epoxy coating with a minimum solids content of 67 percent by volume.
  - 1. Paint Schedule:

	Coat	Coverage	VOC Content (g/L max.)	Manufacturer, or Approved Equivalent
1.	Primary Coat	Filler-Sealer	100	<ol> <li>PPG Amercoat 114A</li> <li>Tnemec Series 1254         EpoxoBlock WB     </li> <li>International Devoe         Devfil 145     </li> <li>Carboguard 501</li> </ol>
2.	Intermediate Coat	4 to 6 DFTPC	250	<ol> <li>PPG Amerlock 2VOC</li> <li>Tnemec Series 66HS Epoxoline</li> <li>International Devoe Devran 224V</li> <li>Carboguard 890</li> </ol>

	Coat	Coverage	VOC Content (g/L max.)	Manufacturer, or Approved Equivalent
3.	Finish Coat	2 or more coats, 3 to 5 DFTPC	250	<ol> <li>PPG Amershield VOC</li> <li>Tnemec Series 1095 En- dura-Shield</li> <li>International Devoe Dev- thane 379H</li> <li>Carbothane 134 VOC</li> </ol>
4.	Total System	10 to 16 DFT		

L. System 12 Aliphatic Polyurethane, Fiber Glass: Two-component aliphatic polyurethane coating material shall provide superior color and gloss retention, resistance to splash from acid and alkaline chemicals, and resistance to chemical fumes and severe weathering. A primer, tie coat, or mist coat shall be used as recommended by the manufacturer.

Coat	Coverage	VOC Content (g/L max.)	Manufacturer, or Approved Equivalent
1. Primary Coat	3 to 4 DFTPC	250	<ol> <li>International Devoe Bar- Rust 231</li> <li>Carboline Carbocrylic 120</li> <li>PPG Amershield VOC</li> <li>Tnemec Series 135 Chem- build</li> </ol>
2. Finish Coat	2 or more coats, 4 to 6 DFTPC	250	<ol> <li>International Devthane 379H</li> <li>Carboline Carbothane 134 VOC</li> <li>PPG Amershield VOC</li> <li>Tnemec Series 1095 En- dura-Shield</li> </ol>
3. Total System	7 to 10 DFT		

1. Paint Schedule:

## 2.3 SUBMERGED AND SEVERE SERVICE COATING SYSTEMS

- A. Material Sources: The manufacturers' products listed in this paragraph are materials which satisfy the material descriptions of this paragraph and have a documented successful record for long term submerged or severe service conditions. Proposed substitute products will be considered as indicated above.
- B. System 100 Amine Cured Epoxy: High build, amine cured, epoxy resin shall have a solids content of at least 80 percent by volume and shall be suitable for long-term immersion service in potable water and municipal wastewater. For potable water service, the coating material shall be listed by the NSF International as in compliance with NSF 61.

Coat	Coverage	VOC Content (g/L max.)	Manufacturer, or Approved Equivalent
1.Primary and Finish Coats	3 or more coats, 4 to 6 DFTPC	250	<ol> <li>Tnemec V140F Pota-Pox Plus</li> <li>Carboline 891 VOC</li> <li>International Devoe Bar- Rust 233H</li> </ol>
2.Total System	15 to 18 DFT		

1. Paint Schedule A (for coating of all surfaces except those indicated in Paint Schedule B below):

2. Paint Schedule B (for coating of non-submerged valves and equipment):

Coat	Coverage	VOC Content (g/L max.)	Manufacturer, or Approved Equivalent
1. Primary and Finish Coats	3 or more coats, 4 to 6 DFTPC	250	<ol> <li>Tnemec V140F Pota-Pox Plus</li> <li>Carboline 891 VOC</li> <li>International Devoe Bar- Rust 233H</li> </ol>
2. Total System	10 to 12 DFT		

- C. System 101 Not Used.
- D. System 102 Polyamide Cured Epoxy: High build, polyamide epoxy resin shall have a solids content of at least 68 percent by volume and shall be suitable for long-term immersion in potable water and municipal wastewater. For potable water service, the coating material shall be listed by the NSF International as in compliance with NSF 61.
  - 1. Paint Schedule:

Coat	Coverage	VOC Content (g/L max.)	Manufacturer, or Approved Equivalent
Total System	3 or more coats, 12 to 18 DFT	250	<ol> <li>Tnemec V140F Pota-Pox Plus</li> <li>International Devoe Bar- Rust 233H</li> <li>Carboguard 891 VOC</li> </ol>

- E. System 103 Not Used.
- F. System 104 Not Used.

- G. System 105 Not Used.
- H. System 106 Fusion Bonded Epoxy: The coating material shall be a 100 percent powder epoxy, certified as compliant with NSF 61, applied in accordance with ANSI/AWWA C213, except that the surface preparation shall be as listed in the coating system schedule of this Section. The coating shall be applied using the fluidized bed or electrostatic spray process.
  - 1. Paint Schedule:

Coat	Coverage	VOC Content (g/L max.)	Manufacturer, or Approved Equivalent
Total System	<ul> <li>Valves: 12 DFT</li> <li>All others: 16 DFT</li> </ul>	0	1. Scotchkote 134 or 206N

2. Liquid Epoxy: For field repairs, the use of a liquid epoxy will be permitted, applied in not less than 3 coats to provide a DFT of 15 mils. The liquid epoxy shall be a 100 percent solids epoxy recommended by the powder epoxy manufacturer.

## 2.4 SPECIAL COATING SYSTEMS

- A. System 200 PVC Tape: Prior to wrapping the pipe with PVC tape, the pipe and fittings first shall be primed using a primer recommended by the PVC tape manufacturer. After being primed, the pipe shall be wrapped with a 20-mil adhesive PVC tape, half-lapped, to a total thickness of 40 mils.
- B. System 201 Rich Portland Cement Mortar: Rich Portland cement mortar coating shall have a minimum thickness of <sup>1</sup>/<sub>8</sub>-inch, followed by enclosure in an 8-mil thick polyethylene sheet with all joints and edges lapped and sealed with tape.
- C. System 203 Not Used.
- D. System 204 Not Used
- E. **System 205 Polyethylene Encasement:** Application of polyethylene encasement shall be in accordance with ANSI/AWWA C105 using Method C.
- F. System 206 Cement Mortar Coating: A 1<sup>1</sup>/<sub>2</sub>-inch minimum thickness mortar coating reinforced with <sup>3</sup>/<sub>4</sub>-inch galvanized welded wire fabric shall be provided. The cement mortar shall contain no less than 1 part Type V cement to 3 parts sand. The cement mortar shall be cured by a curing compound meeting the requirements of "Liquid Membrane Forming Compounds for Curing Concrete," ASTM C 309, Type II, white pigmented, or by enclosure in an 8-mil thick polyethylene sheet with all edges and joints lapped by at least 6 inches.
- G. System 207 Not Used.

- H. System 208 Aluminum Metal Isolation: A 100% solids epoxy or high-build polyamide epoxy coating.
  - 1. Paint Schedule:

Coat	Coverage	VOC Content (g/L max.)	Manufacturer, or Approved Equivalent
Total System	2 or more coats, 16 to 20 DFT	250	<ol> <li>PPG Amerlock 2/GF/Amerlock 400GF</li> <li>Tnemec Series 66HS Epoxo- line</li> <li>International Devoe Devstar 5A-HS</li> <li>Phenoline 341</li> </ol>

# PART 3 - EXECUTION

## 3.1 MANUFACTURER'S SERVICES

- A. The Contractor shall require the protective paint manufacturer to furnish a qualified technical representative to visit the Site for technical support as may be necessary to resolve field problems attributable or associated with the manufacturer's products.
- B. For submerged and severe service coating systems, the Contractor shall require the paint manufacturer to furnish the following services:
  - 1. The manufacturer's representative shall provide at least 6 hours of on-site instruction in the proper surface preparation, use, mixing, application, and curing of the coating systems.
  - 2. The manufacturer's representative shall observe the start of surface preparation, mixing, and application of the coating materials for each coating system.

#### 3.2 WORKMANSHIP

- A. Skilled craftsmen and experienced supervision shall be used on all Work.
- B. Coating shall be done in a workmanlike manner so as to produce an even film of uniform thickness. Edges, corners, crevices, and joints shall receive special attention to insure thorough cleaning and an adequate thickness of coating material. The finished surfaces shall be free from runs, drops, ridges, waves, laps, brush marks, and variations in color, texture, and finish. The hiding shall be so complete that the addition of another coat would not increase the hiding. Special attention shall be given to ensure that edges, corners, crevices, welds, and similar areas receive a film thickness equivalent to adjacent areas, and installations shall be protected by the use of drop cloths or other precautionary measures.
- C. All damage to surfaces resulting from the Work shall be cleaned, repaired, and refinished to original condition.

## 3.3 STORAGE, MIXING, AND THINNING OF MATERIALS

- A. Manufacturer's Recommendations: Unless otherwise indicated, the paint manufacturer's printed recommendations and instructions for thinning, mixing, handling, applying, and protecting its coating materials, for preparation of surfaces for coating, and for all other procedures relative to coating shall be strictly observed.
- B. All protective coating materials shall be used within the manufacturer's recommended shelf life.
- C. Storage and Mixing:
  - 1. Coating materials shall be stored under the conditions recommended by the Safety Data Sheets, SDS, and shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Coatings of different manufacturers shall not be mixed together.
  - 2. All coatings and paints shall be stored in a protected area, or an enclosed structure when necessary, to protect them from weather and excessive heat or cold and maintain temperatures within the range recommended by the paint manufacturer.
  - 3. Flammable coatings or paints must be stored to conform to local, territory, and federal safety codes for flammable coating or paint materials.

### 3.4 APPLICATION

- A. **General:** All surfaces to receive protective coatings shall be cleaned as indicated prior to application of coatings. The Contractor shall examine all surfaces to be coated and shall correct all surface defects before application of any coating material. All marred or abraded spots on shop-primed and on factory-finished surfaces shall receive touch-up restoration prior to any coating application. Surfaces to be coated shall be dry and free of visible dust.
- B. Protection of Surfaces not to be Coated: Surfaces that are not to receive protective coatings shall be protected during surface preparation, cleaning, and coating operations.
- C. All hardware, lighting fixtures, switch plates, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not to be painted shall be removed, masked or otherwise protected. Drop cloths shall be provided to prevent coating materials from falling on or marring adjacent surfaces. The working parts of all mechanical and electrical equipment shall be protected from damage during surface preparation and coating operations. Openings in motors shall be masked to prevent entry of coating or other materials.
- D. Care shall be exercised not to damage adjacent Work during blast cleaning operations. Spray painting shall be conducted under carefully controlled conditions. The Contractor shall be fully responsible for and shall promptly repair any and all damage to adjacent Work or adjoining property occurring from blast cleaning or coating operations.
- E. **Protection of Painted Surfaces:** Cleaning and coating shall be coordinated so that dust and other contaminants from the cleaning process will not fall on wet, newly coated surfaces.
- F. **Dehumidification:** The Contractor shall provide dehumidification of the interior of hydraulic structures during the entire time when surface preparation and coating application are performed. The contractor shall use a dehumidifier capable of providing two complete air changes per hour and capable of maintaining a relative humidity of 35 percent.

G. Final abrasive blast cleaning shall not be performed whenever relative humidity exceeds 85 percent or whenever surface temperature is less than 5° F above the dew point of ambient air.

## 3.5 SURFACE PREPARATION STANDARDS

- A. The following referenced surface preparation specifications of the Society for Protective Coatings (SSPC) shall form a part of this specification:
  - 1. Solvent Cleaning (SSPC-SP 1): Removal of oil, grease, soil, salts, and other soluble contaminants by cleaning with solvent, vapor, alkali, emulsion, or steam.
  - 2. Hand Tool Cleaning (SSPC-SP 2): Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by hand chipping, scraping, sanding, and wire brushing.
  - 3. Power Tool Cleaning (SSPC-SP 3): Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by power tool chipping, descaling, sanding, wire brushing, and grinding.
  - 4. White Metal Blast Cleaning (SSPC-SP 5): Removal of all visible rust, oil, grease, soil, dust, mill scale, paint, oxides, corrosion products and foreign matter by blast cleaning.
  - 5. Commercial Blast Cleaning (SSPC-SP 6): Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 33 percent of each square inch of surface area.
  - 6. Brush-Off Blast Cleaning (SSPC-SP 7): Removal of all visible oil, grease, soil, dust, loose mill scale, loose rust, and loose paint.
  - 7. Near-White Blast Cleaning (SSPC-SP 10): Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 5 percent of each square inch of surface area.
  - 8. Surface Preparation of Concrete (SSPC-SP 13): Removal of protrusions, laitance and efflorescence, existing coatings, form-release agents, and surface contamination by detergent or steam cleaning, abrasive blasting, water jetting, or impact or power tool methods as appropriate for the condition of the surface and the requirements of the coating system.

## 3.6 METAL SURFACE PREPARATION (UNGALVANIZED)

- A. The minimum abrasive blasting surface preparation shall be as indicated in the coating system schedules included at the end of this Section. Where there is a conflict between these specifications and the paint manufacturer's printed recommendations for the intended service, the higher degree of cleaning shall apply.
- B. Workmanship for metal surface preparation shall be in conformance with the current SSPC Standards and this Section.
- C. All oil, grease, welding fluxes, and other surface contaminants shall be removed by solvent cleaning in accordance with SSPC-SP 1 prior to blast cleaning.
- D. All sharp edges shall be rounded or chamfered and all burrs, and surface defects and weld splatter shall be ground smooth prior to blast cleaning.
- E. The type and size of abrasive shall be selected to produce a surface profile that meets the paint manufacturer's recommendation for the particular coating and service conditions. Abrasives for submerged and severe service coating systems shall be clean, hard, sharp cutting crushed slag. Automated blasting systems shall not be used for surfaces that will be in submerged service. Metal shot or grit shall not be used for surfaces that will be in submerged service, even if subsequent abrasive blasting is planned to be one with hard, sharp cutting crushed slag.

- F. The abrasive shall not be reused unless an automated blasting system is used for surfaces that will be in non-submerged service. For automated blasting systems, clean oil-free abrasives shall be maintained. The abrasive mix shall include at least 50 percent grit.
- G. The Contractor shall comply with the applicable federal, state, and local air pollution control regulations for blast cleaning.
- H. Compressed air for air blast cleaning shall be supplied at adequate pressure from well maintained compressors equipped with oil and moisture separators that remove at least 95 percent of the contaminants.
- I. Surfaces shall be cleaned of all dust and residual particles of the cleaning operation by dry air blast cleaning, vacuuming, or another approved method prior to painting.
- J. Enclosed areas and other areas where dust settling is a problem shall be vacuum-cleaned and wiped with a tack cloth.
- K. Damaged or defective coating shall be removed by the blast cleaning to meet the clean surface requirements before recoating.
- L. If the required abrasive blast cleaning will damage adjacent Work, the area to be cleaned is less than 100 square feet, and the coated surface will not be submerged in service, then SSPC-SP 2 or SSPC-SP 3 shall be used.
- M. Shop applied coatings of unknown composition shall be completely removed before the indicated coatings are applied. Valves, castings, ductile or cast-iron pipe, and fabricated pipe or equipment shall be examined for the presence of shop-applied temporary coatings. Temporary coatings shall be completely removed by solvent cleaning in accordance with SSPC-SP 1 before the abrasive blast cleaning Work has been started.
- N. Shop primed equipment shall be solvent cleaned in the field before finish coats are applied.

# 3.7 SURFACE PREPARATION FOR GALVANIZED FERROUS METAL

- A. Galvanized ferrous metal shall be alkaline cleaned in accordance with SSPC-SP 1 to remove oil, grease, and other contaminants detrimental to adhesion of the protective coating system to be used, followed by brush off blast cleaning in accordance with SSPC-SP 7, or SSPC SP-16.
- B. Pretreatment coatings of surfaces shall be in accordance with the printed recommendations of the paint manufacturer.

## 3.8 SURFACE PREPARATION OF FERROUS SURFACES WITH EXISTING COATINGS

- A. **General:** All grease, oil, heavy chalk, dirt, or other contaminants shall be removed by solvent or detergent cleaning prior to abrasive blast cleaning. The generic type of the existing coatings shall be determined by laboratory testing.
- B. Abrasive Blast Cleaning: The Contractor shall provide the degree of cleaning indicated in the coating system schedule for the entire surface to be coated. If the degree of cleaning is not indicated in the schedule, deteriorated coatings shall be removed by abrasive blast cleaning to SSPC-SP 6. Areas of tightly adhering coatings shall be cleaned to SSPC-SP 7, with the remaining thickness of existing coating not to exceed 3 mils.
- C. **Incompatible Coatings:** If coatings to be applied are not compatible with existing coatings the Contractor shall apply intermediate coatings in accordance with the paint manufacturer's recommendation for the indicated coating system or shall completely remove the existing coating prior to abrasive blast cleaning. A small trial application shall be conducted for compatibility prior to painting large areas.
- D. Unknown Coatings: Coatings of unknown composition shall be completely removed prior to application of new coatings.
- E. Water Abrasive or Wet Abrasive Blast Cleaning: Where indicated or where Site conditions do not permit dry abrasive blasting for industrial coating systems due to dust or air pollution considerations, water abrasive blasting or wet abrasive blasting may be used. In both methods,
paint-compatible corrosion inhibitors shall be used, and coating application shall begin as soon as the surfaces are dry. Water abrasive blasting shall be done using high pressure water with sand injection. In both methods, the equipment used shall be commercially produced equipment with a successful service record. Wet blasting methods shall not be used for submerged and severe service coating systems unless indicated.

## 3.9 CONCRETE AND CONCRETE BLOCK MASONRY SURFACE PREPARATION

- A. Surface preparation shall not begin until at least 30 days after the concrete or masonry has been placed.
- B. All oil, grease, and form release and curing compounds shall be removed by solvent or detergent cleaning in accordance with SSPC-SP 1, followed by surface preparation meeting the requirements of SSPC-SP 13.
- C. Concrete, concrete block masonry surfaces and deteriorated concrete surfaces to be coated shall be brush-off blast cleaned with caution to remove existing coatings, laitance, deteriorated concrete, and to roughen the surface equivalent to the surface of the No. 80 grit flint sandpaper.
- D. If acid etching is required by the coating application instructions, the treatment shall be made after brush-off blast cleaning. After etching, rinse surfaces with water and test the pH value. The pH shall be between neutral and 8. Acid etching of vertical or overhead surfaces shall not be allowed.
- E. Surfaces shall be clean and as recommended by the paint manufacturer before coating is started. Secure paint manufacturer's recommendations for additional preparation, if required, for excessive bug holes exposed after blasting.
- F. Unless required for proper adhesion, surfaces shall be dry prior to coating. The presence of moisture shall be determined with a moisture detection device such as **Delmhorst Model DB**, or approved equivalent.

## 3.10 PLASTIC, FIBER GLASS AND NONFERROUS METALS SURFACE PREPARATION

- A. Plastic and fiber glass surfaces shall be sanded or brush off blast cleaned prior to solvent cleaning with a chemical compatible with the coating system primer.
- B. Non-ferrous metal surfaces shall be solvent-cleaned in accordance with SSPC-SP 1, followed by sanding or brush-off blast cleaning in accordance with SSPC-SP 7.
- C. All surfaces shall be clean and dry prior to coating application.

## 3.11 ARCHITECTURAL CONCRETE BLOCK MASONRY SURFACE PREPARATION

- A. The mortar surfaces shall be cured at least 14 days before surface preparation Work is started.
- B. Dust, dirt, grease, and other foreign matter shall be removed prior to abrasive blasting.
- C. The masonry surfaces shall be prepared in accordance with the material manufacturer's printed instructions.

## 3.12 SHOP COATING REQUIREMENTS

A. Unless otherwise indicated, all items of equipment, or parts of equipment which are not submerged in service, shall be shop primed and then finish coated in the field after installation with the indicated or selected color. The methods, materials, application equipment and all other details of shop painting shall comply with this section. If the shop primer requires topcoating within a specified period of time, the equipment shall be finish coated in the shop and then touch-up painted after installation.

- B. All items of equipment, or parts and surfaces of equipment, which are submerged or inside an enclosed hydraulic structure when in service, with the exception of pumps and valves, shall have all surface preparation and coating Work performed in the field.
- C. For certain pieces of equipment, it may be undesirable or impractical to apply finish coatings in the field. Such equipment may include engine generator sets, equipment such as electrical control panels, switchgear or main control boards, submerged parts of pumps, ferrous metal passages in valves, or other items where it is not possible to obtain the indicated quality in the field. Such equipment shall be primed, and finish coated in the shop and touched up in the field with the identical material after installation. The Contractor shall require the manufacturer of each such piece of equipment to certify as part of its Shop Drawings that the surface preparation is in accordance with these specifications. The coating material data sheet shall be submitted with the Shop Drawings for the equipment.
- D. For certain small pieces of equipment, the manufacturer may have a standard coating system that is suitable for the intended service conditions. In such cases, the final determination of suitability will be made during review of the Shop Drawing submittals. Equipment of this type generally includes only indoor equipment such as instruments, small compressors, and chemical metering pumps.
- E. Shop painted surfaces shall be protected during shipment and handling by suitable provisions including padding, blocking, and the use of canvas or nylon slings. Primed surfaces shall not be exposed to the weather for more than 2 months before being top-coated or less time if recommended by the paint manufacturer.
- F. Damage to shop-applied coatings shall be repaired in accordance with this Section and the paint manufacturer's printed instructions.
- G. The Contractor shall make certain that the shop primers and field topcoats are compatible and meet the requirements of this Section. Copies of applicable paint manufacturer's data sheets shall be submitted with equipment Shop Drawings.

# 3.13 APPLICATION OF COATINGS

- A. The application of protective coatings to steel substrates shall be in accordance with SSPC-PA 1.
- B. Cleaned surfaces and all coats shall be inspected prior to each succeeding coat. The Contractor shall schedule such inspection with the Contracting Officer in advance.
- C. Blast cleaned ferrous metal surfaces shall be painted before any rusting or other deterioration of the surface occurs. Blast cleaning shall be limited to only those surfaces that can be coated in the same working day.
- D. Coatings shall be applied in accordance with the manufacturer's instructions and recommendations, and this Section, whichever has the most stringent requirements.
- E. Special attention shall be given to edges, angles, weld seams, flanges, nuts and bolts, and other places where insufficient film thicknesses are likely to be present. Use stripe painting for these areas.
- F. Special attention shall be given to materials that will be joined so closely that proper surface preparation and application are not possible. Such contact surfaces shall be coated prior to assembly or installation.
- G. Finish coats, including touch-up and damage repair coats shall be applied in a manner that will present a uniform texture and color matched appearance.
- H. Coatings shall not be applied under the following conditions:
  - 1. Wet or damp surfaces.
  - 2. Temperature and moisture conditions outside of the manufacturer's recommended maximum and minimum allowable.
  - 3. Dust or smoke laden atmosphere.
  - 4. Damp or humid weather.

- 5. When the substrate or air temperature is less than  $5 \square F$  above dew point.
- 6. When air temperature is expected to drop below 40  $\Box$ F or less than 5  $\Box$ F above the dew point within 8 hours after application of coating.
- 7. When wind conditions are not calm.
- 8. In conditions not recommended by the manufacturer.
- I. Dew point shall be determined by use of a sling psychrometer in conjunction with U.S. Dept. of Commerce, Weather Bureau psychometric tables.
- J. Unburied steel piping shall be abrasive blast cleaned and primed before installation.
- K. The finish coat on all Work shall be applied after all concrete, masonry, and equipment installation is complete and the Work areas are clean and dust free.

# 3.14 CURING OF COATINGS

- A. The Contractor shall maintain curing conditions in accordance with the conditions recommended by the coating material manufacturer or by this Section, whichever is the most stringent, prior to placing the completed coating system into service.
- B. In the case of enclosed areas, forced air ventilation, using heated air if necessary, may be required until the coatings have fully cured.
- C. Forced Air Ventilation of Enclosed Hydraulic Structures: Forced air ventilation is required for the application and curing of coatings on the interior surfaces of enclosed hydraulic structures. During application and curing periods, continuously exhaust air from the lowest level of the structure using portable ducting. After all interior coating operations have been completed, provide a final curing period for a minimum of 10 days, during which the forced ventilation system shall operate continuously. For additional requirements, refer to the specific coating system requirements in Part 2 above.

## 3.15 SHOP AND FIELD INSPECTION AND TESTING

- A. General: The Contractor shall give the Contracting Officer a minimum of 3 days advance notice of the start of any field surface preparation Work or coating application Work, and a minimum of 7 days advance notice of the start of any shop surface preparation Work.
- B. All such Work shall be performed only in the presence of the Contracting Officer, unless the Contracting Officer has granted prior approval to perform such Work in its absence.
- C. Inspection by the Contracting Officer, or the waiver of inspection of any particular portion of the Work, shall not relieve the Contractor of its responsibility to perform the Work in accordance with these Specifications.
- D. Scaffolding shall be erected and moved to locations where requested by the Contracting Officer to facilitate inspection. Additional illumination shall be furnished to cover all areas to be inspected.
- E. **Inspection Devices:** The Contractor shall furnish, until final acceptance of such coatings, inspection devices in good working condition for the detection of holidays and measurement of dry-film thicknesses of protective coatings. Dry-film thickness gauges shall be made available for the Contracting Officer's use at all times while coating is being done, until final acceptance of such coatings. The Contractor shall also furnish US Department of Commerce, National Bureau of Standards certified thickness calibration plates to test accuracy of dry-film thickness gauge. All inspection devices shall be in good working order. The Contractor shall furnish the services of a trained operator of the holiday detection devices until the final acceptance of such coatings. Holiday detection devices shall be operated only in the presence of the Contracting Officer.
- F. **Holiday Testing:** The Contractor shall holiday test all coated ferrous surfaces which will be submerged in water or other liquids or surfaces which are enclosed in a vapor space in structures and surfaces coated with any of the submerged and severe service coating systems. Areas that contain holidays shall be marked and repaired or recoated in accordance with the paint manufac-

turer's printed instructions and then retested. No pinholes or other irregularities will be permitted in the final coating.

- Coatings with Thickness Exceeding 20 mils: For surfaces having a total dry film coating thickness exceeding 20 mils: pulse-type holiday detector such as Tinker & Rasor Model AP-W, D. E. Stearns Co. Model 14/20, or Approved Equivalent shall be used. The unit shall be adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the required coating thickness.
- 2. Coatings with Thickness of 20 mils or Less: For surfaces having a total dry film coating thickness of 20 mils or less: Tinker & Rasor Model M-1 non-destructive type holiday detector, K-D Bird Dog, or approved equivalent shall be used. The unit shall operate at less than 75 volts. For thicknesses between 10 and 20 mils, a non-sudsing type wetting agent, such as Kodak Photo-Flo, or Approved Equivalent, shall be added to the water prior to wetting the detector sponge.
- G. Film Thickness Testing: On ferrous metals, the dry film coating thickness shall be measured in accordance with the SSPC "Paint Application Specification No. 2" using a magnetic-type dry film thickness gauge such as Mikrotest Model FM, Elcometer Model 111/1EZ, or Approved Equivalent. Each coat shall be tested for the correct thickness. No measurements shall be made until at least 8 hours after application of the coating. On non-ferrous metals and other substrates, the coating thicknesses shall be measured at the time of application using a wet film gauge.
- H. **Surface Preparation:** Evaluation of blast cleaned surface preparation work will be based upon comparison of the blasted surfaces with the SSPC visual standards for the final ferrous surface condition. The Contractor shall furnish appropriate SSPC visual reference photographs available for the Contracting Officer's use at all time when surface preparation Work is being performed.
  - 1. Tool cleaned surfaces prepared in accordance with the requirements of SSPC-SP 2 and SSPC-SP 3, as a visual reference, shall be similar to the visual reference photographs in SSPC-VIS 3.
  - 2. Abrasive blast cleaned surfaces prepared in accordance with the requirements of SSPC-SP 7, SSPC-SP 6, and SSPC-SP 10, as a visual reference, shall be similar to the visual reference photographs in SSPC-VIS 1.

# 3.16 COATING SYSTEM SCHEDULE – FERROUS METALS

A. Coating System Schedule, Ferrous Metal - Not Galvanized:

	Item	Surface Preparation	System No.
FM-1	All surfaces indoors and outdoors, exposed or cov- ered, except those included below.	Near white metal blast cleaning SSPC-SP 10	(5) inorganic zinc/polyurethane
FM-2	Not Used.		

	Item	Surface Preparation	System No.
FM-3	Surfaces of equipment and ferrous surfaces submerged or intermittently submerged in potable water, utility wa- ter, and wastewater includ- ing all surfaces lower than 2 feet above high water level in hydraulic structures, and all surfaces inside enclosed hydraulic structures and vents (excluding shop- coated valves, couplings, pumps).	White metal blast cleaning SSPC-SP 5	(100) amine-cured epoxy
FM-4 and FM-5	Not Used.		
FM-6	Buried small steel pipe.	Removal of dirt, grease, oil	(200) PVC tape
FM-7	Where indicated, ferrous surfaces in water passages of all valves 2-inch size and larger, exterior surfaces of submerged valves.	White metal blast cleaning SSPC-SP 5	(102) polyamide-cured epoxy
FM-8	Not Used.		
FM-9	Ferrous surfaces of sleeve couplings.	Solvent cleaning SSPC-SP 1, followed by white metal blast cleaning SSPC-SP10	(106) fusion-bonded epoxy
FM-10	All ferrous surfaces of flap gates, including wall thimbles.	White metal blast cleaning SSPC-SP 5	(102) polyamide-cured epoxy
FM-11	Buried surfaces that are not indicated to be coated else-where.	Near white metal blast cleaning SSPC-SP 10	(100) amine-cured epoxy
FM-12 to FM-15	Not Used.		
FM-16	Surfaces of indoor equip- ment and piping not sub- merged.	Commercial blast cleaning SSPC-SP 6 for equipment, and near White Metal Blast Cleaning SSPC-SP 10 for piping	(8) epoxy, equipment
FM-17	Not Used.		

	Item	Surface Preparation	System No.
FM-18	Buried pipe couplings, valves, fittings, and flanged joints (where piping is plas- tic).	Removal of dirt, grease, oil	(201) rich Portland cement mortar
FM-19	Buried pipe couplings, valves, and flanged joints (where piping is ductile or cast iron, not tape-coated), including factory-coated surfaces.	As specified by reference specification	(205) polyethylene encase- ment
FM-20	Buried pipe couplings, valves, and flanged joints (where piping is mortar- coated steel or reinforced concrete), including factory- coated surfaces.	Removal of dirt, grease, oil	(206) cement-mortar coat- ing

B. Coating System Schedule, Ferrous Metal Galvanized: Pretreatment coatings, barrier coatings, or washes shall be applied as recommended by the paint manufacturer. All galvanized surfaces shall be coated except for the following items which shall be coated only if required by other Sections: (1) Floor gratings and frames, (2) Handrails, (3) Stair treads, (4) Chain link fencing and appurtenances.

	Item	Surface Preparation	System No.
FMG-1	All exposed surfaces in- doors and outdoors, except those included below.	Solvent cleaning SSPC-SP 1	(4) aliphatic polyure- thane
FMG-2	Surfaces in chlorinator room, chlorine storage room.	Solvent cleaning SSPC-SP 1	(100) amine-cured epoxy
FMG-3	Buried small steel pipe.	Removal of dirt, grease, oil	(200) PVC tape
FMG-4	Surfaces buried or sub- merged in water or wastewater, including all surfaces lower than two feet above high water level and all surfaces inside en- closed hydraulic structures and vents.	Solvent cleaning SSPC-SP 1 followed by brush-off grade blast cleaning SSPC-SP 7	(100) amine-cured epoxy

## 3.17 COATING SYSTEM SCHEDULE – NON-FERROUS METAL, PLASTIC, FIBERGLASS

A. Where isolated non-ferrous parts are associated with equipment or piping, the Contractor shall use the coating system for the adjacent connected surfaces. Do not coat handrails, gratings, frames or hatches. Only primers recommended by the paint manufacturer shall be used.

	Item	Surface Preparation	System No.
NFM-1	All exposed surfaces, in- doors and outdoors, except those included below.	Solvent cleaned SSPC-SP 1	(4) aliphatic polyure- thane
NFM-2	Not Used.		
NFM-3	Aluminum surfaces in con- tact with concrete, or with any other metal except gal- vanized ferrous metal.	Solvent cleaned SSPC-SP 1	(208) aluminum metal isolation
NFM-4	Polyvinyl chloride plastic piping, indoors and out- doors, or in structures, not submerged.	Solvent cleaned SSPC-SP 1	(7) acrylic latex
NFM-5	Fiber glass surfaces.	Per paragraph 3.10	(12) aliphatic polyure- thane fiber glass
NFM-6	Buried non-ferrous metal pipe.	Removal of dirt, grease, oil	(200) PVC tape

# 3.18 COATING SYSTEM SCHEDULE – CONCRETE

	Item	Surface Preparation	System No.
C-1	All surfaces indoors and out- doors, where indicated.	Per paragraph 3.9, herein.	(11) aliphatic polyurethane, concrete

## END OF SECTION 099000

#### SECTION 221124 – VERTICAL MULTI-STAGE PUMP AND MOTOR

#### PART 1 - GENERAL

#### 1.1 SUMMARY

The Contractor shall provide and install complete frame mounted, vertical in-line multi-stage centrifugal pumping units including frame and electric motor drive. All items listed above, and any additional components that are part of the pump assembly, shall be obtained from a single pump manufacturer.

#### 1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. The work in this section is subject to the requirements of applicable portions of the following standards:
  - 1. ANSI American National Standards Institute
  - 2. ASTM American Society for Testing and Materials
  - 3. Hydraulic Institute
  - 4. IEEE Institute of Electrical and Electronics Engineers
  - 5. ISO International Standards Organization
  - 6. NEC National Electrical Code
  - 7. NEMA National Electrical Manufacturers Association

#### 1.3 SUBMITTALS

- A. Shop Drawings and Manufacturer's Data:
  - 1. Complete fabrication, assembly, foundation, and installation drawings, together with detailed specifications and data covering material used, parts, devices, and other accessories forming a part of the pumping unit.
  - 2. Pump materials of construction, including casing, bearings, and wetted parts.
  - 3. Provide results of a non-witnessed factory test. The factory test shall conform to the requirements of the Hydraulic Institute. Information submitted shall include a head/capacity curve, shaft brake horsepower curve, pump efficiency over the entire range of the pump, guarantee point, NPSH<sub>R</sub>, and overall pumping unit efficiency. The manufacturer shall indicate points on the H/Q curves in tabular format, and the limits recommended for stable operation between which the pumps may be operated without surge, cavitation or vibration.
  - 4. Written certification from the pump manufacturer, addressed to the Owner, stating that the equipment will efficiently and thoroughly perform the required functions in accordance with these Specifications and as shown, and that the pump

manufacturer accepts joint responsibility with the Contractor for coordination of all equipment, including motors, variable speed drives, controls, and services required for proper installation and operation of the completely assembled and installed pumps.

- 5. Motor Data: Complete motor data shall be submitted in the shop drawings for driven machinery. Motor data shall include:
  - a. Machine name and specification number of driven machine.
  - b. Name of the motor manufacturer.
  - c. Motor type or model and dimension drawing. Include motor weight.
  - d. Nominal horsepower.
  - e. NEMA design.
  - f. Enclosure.
  - g. Frame Size.
  - h. Winding insulation class and temperature rise class.
  - i. Voltage, phase and frequency ratings.
  - j. Service factor.
  - k. Full load current at rated horsepower for application voltage.
  - I. Full load speed.
  - m. Guaranteed minimum full load efficiency. Also provide nominal efficiencies at  $\frac{1}{2}$  and  $\frac{3}{4}$  load.
  - n. Type of thermal protection or over temperature protection.
  - o. Wiring diagram for devices such as motor leak detection, temperature, or zero speed switches, as applicable.
  - p. Bearing data, with recommended lubricants for relubricatable type bearings.
  - q. Power factor at 1/2, 3/4 and full load.
  - r. If used with a variable frequency controller, provide written verification that motor is inverter duty type. Include minimum speed at which motor may be operated for the driven machinery.
  - s. Recommended size for power factor correction capacitors to improve power factor to 0.95 (lagging) when operated at full load.

- t. Dimensions and location of all conduit termination boxes.
- u. Quantity and size of conduit openings for each conduit box. Openings shall accommodate the quantity and size of conduits indicated on the Drawings.
- 6. Prior to startup, the Contractor shall furnish the Owner complete operations and maintenance manuals and recommended spare parts lists.

# 1.4 QUALITY ASSURANCE

- A. All pumping equipment furnished under this Section shall be of a design and manufacture that has been used in similar applications, and it shall be demonstrated to the satisfaction of the Owner that the quality is equal to equipment made by that manufacturer specifically named herein.
- B. Unit responsibility. Pump(s), complete with motor, frame, and all other specified accessories and appurtenances shall be furnished by the pump manufacturer to ensure compatibility and integrity of the individual components, and provide the specified warranty for all components.
- C. Operating speed of the pump shall be at least 25% away from the critical speeds of the shaft to prevent resonance. For pumps with variable frequency drives, bearing spacing shall be such that the maximum pump operating speed is at least 25% less than the first critical speed.

# 1.5 FACTORY TESTING

- A. Inspection and Testing Cost
  - 1. The Contractor shall be responsible for all costs associated with inspection and testing of materials, products, or equipment at the place of manufacture. This shall include costs for travel, meals, lodging, and car rental for four (4) Owner-designated inspectors as required to complete such inspections or observations, exclusive of travel days. <u>Training shall be provided for the Hydro MPC packaged booster systems, including the CU 352 controller.</u>
- B. Pumps
  - 1. All pumps shall be performance tested at the manufacturer's plant. The performance shall be within the limits set forth by the Hydraulic Institute. The test shall be conducted after the impeller diameters have been trimmed to meet the duty head requirements. The project motor shall be used as the pump test driver.
  - 2. All testing shall be carried out in conformity with the applicable sections of the standards of ANSI/AWWA E101-88 and current revision and the Hydraulic Institute.
  - 3. As a minimum, each finished pump shall be performance tested for total dynamic head, capacity, efficiency and power requirements at six (6) operating points plus

shut-off head for the selected impeller diameter, of which, the design capacity operating point shall be included.

4. In the event of failure of any pump to meet any of the design requirements or efficiencies, the manufacturer shall make all necessary modifications, repairs, or replacements to conform to the requirements of the Contract Documents, and the pump shall be re-tested with no additional compensation, until found satisfactory.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

The pumps shall be manufactured by Grundfos; no equal.

# 2.2 OPERATING CONDITIONS

A. Each pump will be used for pumping chlorinated potable water. The capacities, heads, efficiencies, and horsepower requirements specified herein are for completely assembled units. Each pumping unit shall meet the requirements and design points as specified. (See Figure 1 for system curves).

Pump Parameters	P-301, P-302
Pump Models	Grundfos CRN 64-3-1
Liquid to be Pumped	Potable Water
Capacity at Point #1	256 gpm
Minimum Head at Point #1	293 ft
Capacity at Point #2 (Guarantee Point)	366 gpm
Minimum Head at Point #2	235 ft
Minimum Pump Efficiency at Point #2	70
Capacity at Point #3	420 gpm
Minimum Head at Point #3	198 ft
Maximum NPSHr at Point #3	25 ft
Motor Horsepower	40
Motor Driver Type	VFD
Max. Rotational Speed	1,750 rpm



## 2.3 PUMP CONSTRUCTION

- A. All pump bearings shall be lubricated by the pumped liquid.
- B. Each pump shall be designed for in-line installation that can be mounted on a 2 ft by 2 ft concrete pad.
- C. The pump impellers shall be secured directly to the smooth pump shaft by means of a split cone and nut design.
- D. Pump Materials.

1.	Pump head:	Stainless Steel (CF 8M)
2.	Motor Stool:	316 Stainless Steel (AISI 316)
3.	Shaft:	316 Stainless Steel (AISI 316)
4.	Impeller:	316 Stainless Steel (AISI 316)
5.	Chamber:	316 Stainless Steel (AISI 316)

6.	Sleeve:	316 Stainless Steel (AISI 316)
7.	O-ring for sleeve:	EPDM
8.	Base:	Stainless Steel (CF 8M)
9.	Neck Ring:	Carbon-Graphite-Filled PTFE
10.	Bearing Ring:	Silicon Carbide
11.	Base Plate:	316 Stainless Steel (AISI 316)
12.	Flange ring:	316 Stainless Steel (AISI 316)
13.	Rubber parts:	EPDM

E. The shaft mechanical seal shall be a single balanced metal bellows cartridge with the following construction:

1.	Bellows:	316L Stainless Steel
2.	Shaft Sleeve, Gland Plate, Drive Collar:	316 Stainless Steel (AISI 316)
3.	Stationary Ring:	Silicon Carbide
4.	Rotating Ring:	Silicon Carbide
5.	O-rings:	EPDM

- F. Shaft seal replacement shall be possible without removal of any pump components other than the coupling guard, motor couplings, motor and seal cover. Pumps with motors equal to or larger than 15 HP shall have adequate space within the motor stool so that shaft seal replacement is possible without motor removal.
- G. The maximum working temperature shall be 250 degrees F. The maximum working pressure shall be 250 psig.

## 2.4 FRAME

A rigid, channel type carbon steel mounting frame shall be provided which maintains support and alignment of the complete pump and drive motor assembly. The frame shall be suitable for anchor bolt floor mounting and include provision for grouting in place by the installing contractor. The pump manufacturer shall provide recommended mounting instructions and seismic calculations (if requested) to substantiate that mounting is suitable for the application.

#### 2.5 PUMP MOTORS

- A. General
  - 1. Identical Motors: Electric motors driving identical machines shall be identical.

- 2. Maximum Motor Loading: Maximum motor loading shall in all cases be equal to nameplate horsepower rating or less, exclusive of service factor and as verified with the approved submittal data of the driven machinery.
- 3. Minimum Motor Horsepower: All motors shall be sized to carry continuously all loads that may be imposed through their full range of operation. The motor horsepower shall be not less than the estimated minimum specified for each driven machine. If the estimated minimum horsepower specified is not adequate to satisfy the foregoing restrictions or any other requirements of these Specifications, the motor with the required horsepower shall be supplied at no additional cost to the Owner. In addition, any changes caused by increase in motor horsepower shall be made by the Contractor at no additional cost to the Owner; such changes may involve circuit breakers, magnetic starters, motor feeder conductors, conduit sizes, etc.
- 4. Exempt Motors: Motors that are for valve operators, submersible pumps, or motors that are an integral part of standard manufactured equipment, i.e., non-NEMA mounting, common shaft with driven element, part of domestic or commercial use apparatus, may be excepted from these Specifications to the extent that such variation reflects a necessary condition of motor service or a requirement of the driven equipment.

# B. DESIGN REQUIREMENTS

- 1. General: All electric motors shall comply with ANSI/NEMA MG 1 Motor and Generator.
- 2. NEMA Design: Electric motors shall be NEMA Design B, constant speed squirrelcage induction motors having normal starting torque with low starting current. In no case shall starting torque or breakdown torque be less than the value in ANSI/NEMA MG 1. Motors shall be suitable for the starting method indicated on the Electrical Drawings. Motors for pumps operated from a VFD shall be "inverter duty" rated. Inverter duty rating shall be clearly labeled on the motor nameplate.
- 3. Motor Voltage Ratings: Motors shall be rated 460V, 3-phase, 60-Hz, as required and as indicated.
- 4. Insulation: All three-phase motors shall be furnished with Class F insulation, rated to operate at a maximum temperature of 155°C and at the altitudes where the motors will be installed and operated, without exceeding Class B temperature rise limits stated in ANSI/NEMA MG 1-12.42. Single-phase motors shall have Class F insulation with temperature rise not to exceed the insulation class.
- 5. Motors in Nonhazardous Areas: Motors shall have a service factor of 1.15 unless otherwise indicated.
- 6. Motor Enclosure: Motor enclosure for Pumps P-301 and P-302 shall be TEFC.
- 7. High Efficiency Motors:

- a. Motors with a nameplate rating of 1 hp and above shall be NEMA premium efficiency units with nominal efficiencies meeting the NEMA published values. Motors shall be stamped with the efficiency on the nameplate with the caption "NEMA Nominal Efficiency" or "NEMA Nom. Eff." Such motors shall have efficiencies determined by the test as set forth in ANSI/IEEE 112-Standard Test Procedure for Polyphase Induction Motors and Generators, Method B.
- b. Efficiency Index: Efficiency index, nominal efficiency, and minimum efficiency shall be defined in accordance with ANSI/NEMA MG 12.53 Motor Testing; these values shall be stated in the shop drawing submittal.

# C. ACCESSORY REQUIREMENTS

- 1. General: Horizontal motors 3 hp and larger, and all vertical motors, shall have split-type cast metal conduit boxes. Motors other than open drip-proof shall be gasketed. Conduit boxes shall be sized one size larger than the standard conduit box. Motors less than 3 hp shall have the manufacturer's standard conduit boxes. Conduit boxes shall be provided with conduit openings to accommodate the quantity and size of conduits as indicated on the Drawings.
- 2. Lifting Devices: All motors weighing 265 pounds or more shall have suitable lifting eyes for installation and removal.
- 3. Special Requirements: Refer to individual equipment specifications for special requirements such as motor winding thermal protection, multi-speed windings, etc.
- 4. Grounding Lugs: Provide motor grounding lug suitable to terminate ground wire, sized as indicated on the Drawings.
- 5. Nameplate: All motors shall be fitted with a permanent, stainless steel nameplate indelibly stamped or engraved with NEMA Standard motor data, in conformance with NEMA MG-1-10.40.

## D. MOTOR THERMAL PROTECTION

- 1. Single Phase Motors: All single-phase 120, 208, or 230 V motors shall have integral thermal overload protection or shall be inherently current limited.
- 2. Thermostats: Winding thermostats shall be snap action, bi-metallic, temperatureactuated switch. Thermostats shall be provided with one normally open contact. The thermostat switch point shall be pre-calibrated by the manufacturer. Thermostats shall be provided for 3 phase pump motors 200HP and below. Provide separate terminal box for thermostats. Terminal box shall be provided with conduit openings to accommodate the quantity and size of conduit as indicated on the Drawings.

## E. MOTOR SPACE HEATER

1. Provide motor space heater as indicated on the drawings. Provide separate terminal box for space heater. Terminal box shall be provided with conduit openings to accommodate the quantity and size of conduit as indicated on the Drawings.

# F. MOTOR BEARINGS

- 1. Bearing Life: All motors greater than 2 hp shall have bearings designed for a minimum rated L-10 life of 10 years or 100,000 hours, whichever comes first.
- 2. Fractional Horsepower: Fractional horsepower through 2-hp motors shall be furnished with Lubricated-for-Life ball bearings.
- 3. Horizontal Motors over 2 Horsepower: Motors larger than 2-hp shall be furnished with relubricatable ball bearings.
- 4. Vertical Motors over 2 Horsepower: Vertical motors larger than 2-hp shall be furnished with relubricatable ball, spherical, roller, or plate type thrust bearings. Lubrication shall be per the manufacturer's recommendation for smooth operation and long life of the bearings.
- 5. Bearings shall be insulated from the housing to eliminate passage of shaft currents to the bearings. If the bearings are interchangeable, both bearings shall be insulated.

## G. FACTORY TESTING

- 1. Certified test reports shall be supplied for all motors prior to shipment. Noise level test results shall be provided except when acceptable noise level test results can be provided for a similar motor that has been previously tested.
- 2. Certified factory test results shall provide the following data:
  - a. No load running current.
  - b. Locked rotor current.
  - c. High potential test.
  - d. Winding resistance.
  - e. No load vibration check.
  - f. Temperature rise of the winding and bearings taken from a full load heat run conducted until these temperatures become constant.
  - g. Full load current and speed, starting, staring current and torque, breakdown torque, efficiency and power factor at 1/2, 3/4, and full load.
  - h. Peak-to-peak amplitude of vibration under no load.

- i. Speed torque curve.
- j. The efficiency shall be certified per MG1-12, 53a, IEEE-112, Test method B and shall not be less than the manufacturer's guaranteed efficiency.

## H. MANUFACTURERS

- 1. The Contractor's designated equipment supplier shall have the responsibility to select and supply suitable electric motors for the driven equipment. The choice of motor manufacturer shall be subject to review by the Owner and Construction Manager. Such review will consider the future availability of replacement parts and compatibility with driven equipment. Acceptable manufacturers include the following, or equal:
  - a. Baldor

# PART 3 - EXECUTION

## 3.1 GENERAL

- A. Each pumping unit shall be installed per the manufacturer's recommendations. The pump manufacturer shall approve clearances and configuration prior to shipping.
- B. The Contractor shall be responsible for verifying all existing dimensions and make any modifications to accommodate any discrepancies. Any procedures for verifying dimensions and all actions and items required for verifying dimensions are the Contractor's responsibility.

## 3.2 ACCEPTANCE TESTING

- A. After installation, Contractor shall perform a field test on each pump. The pump manufacturer's authorized representative shall be present for the field test. The test shall demonstrate to the satisfaction of the Owner that the equipment meets all specified performance criteria, is properly installed and anchored, and operates smoothly throughout the specified speed range without exceeding the full load amperage rating of the motor or excessive motor heating. The Contractor shall furnish all labor, piping, equipment, and materials, necessary for conducting the tests.
- B. During the tests, head, capacity, input horsepower, and overall pumping unit efficiency values will be determined for at least four points in the stated operating range of the pump, and will be compared with the certified curves. The pump units shall perform in the field as shown on the certified pump curves furnished by the Contractor after reasonable allowances for field conditions.
- C. The pumps shall operate within the acceptable field vibration limits as established by the Hydraulic Institute for this class of equipment at all speeds and within the specified operating range.
- D. Defects or defective equipment revealed by or noted during the tests shall be corrected or replaced promptly at the expense of the Contractor, and, if necessary, the tests shall be

repeated until satisfactory results are obtained. All adjustments necessary to place the equipment in satisfactory working order shall be made at the time of the above tests.

E. In case the Contractor is unable to demonstrate to the satisfaction of the Engineer that the station will satisfactorily perform the service required and that it will operate without excessive vibration and heating, the station will be rejected. The Contractor is responsible for providing, removing, or replacing any equipment or components necessary to bring the station into compliance, including all labor, materials, expenses, and additional testing, without additional compensation.

## 3.3 TOOLS AND SPARE PARTS

- A. The Contractor shall provide one set of all special tools required to properly service the equipment specified herein. Such tools shall be provided in a suitable steel tool chest with lock and duplicate keys. Contractor shall also provide a list of special tools.
- B. Spare parts shall be packed in containers that are clearly identified with indelible markings on containers.
- C. Spare parts information for all equipment furnished shall be supplied. These spare parts lists shall include those recommended by the manufacturer to be maintained in inventory by the Owner.
- D. The Contractor shall provide one complete set of the manufacturer's standard spare parts for each pump. The following spare parts are required at a minimum:
  - 1. For Each Pump
    - a. One suction bell bearing assembly
    - b. One set of all bowl and discharge case bearings
    - c. One set of impellers
    - d. One set of all wear rings
    - e. One set of all pump shaft bearings
    - f. One set, all o-rings, seals, and gaskets

## 3.4 WARRANTY

- A. The Contractor shall guarantee the installation and machinery furnished to perform in accordance with the conditions specified above.
- B. The Contractor's warranty shall extend for one (1) full year from the Owner's acceptance of the job.
- C. The Contractor will perform any and all repair service at his expense including the costs of removing the motors and pumps and the replacing of same.

- D. Any repair work necessary will be accomplished promptly and speedily so as not to jeopardize the public health.
- E. The Owner shall be the sole judge as to what may be interpreted as an unreasonable delay in making repairs during the one (1) year warranty period.
- F. Pump manufacturer shall warrant all equipment they provide for one (1) full year from the Owner's acceptance of the job.

## 3.5 FIELD SERVICE

- A. A start-up service technician shall be made available for start-up, inspection, commissioning, and necessary adjustments. Services shall include, but not necessarily be limited to, inspection of the completed installation to ensure that it has been performed in accordance with the project specifications and manufacturer's instructions and recommendations, and supervision of all field-testing. The start-up technician shall be a regular employee of the Manufacturer.
- B. The Contractor shall be responsible for coordinating the required field services with the pump manufacturer.

END OF SECTION 221124

# SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

# PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. This section does not apply to Instrumentation and Control Voltage wiring.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Copper building wire rated 600 V or less.
  - 2. Connectors, splices, and terminations rated 600 V and less.
- B. Related Requirements:
  - 1. Section 260523 "Control-Voltage Electrical Power Cables" for control systems communications cables and Classes 1, 2, and 3 control cables.

#### 1.3 DEFINITIONS

- A. RoHS: Restriction of Hazardous Substances.
- B. VFC: Variable-frequency controller.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: Indicate type, use, location, and termination locations.
- C. Calculations: Submit wire/cable pulling schedule and calculations.
- D. Methods: Submit types of connectors and termination methods for each piece of equipment, to include motors.

## 1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer's authorized service representative.

B. Field quality-control reports.

## PART 2 - PRODUCTS

## 2.1 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Standards:
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
  - 2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- C. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
- D. Conductor Insulation:
  - 1. Type USE-2: Comply with UL 854.
  - 2. Type THHN: Comply with UL 83.
  - 3. Type THW: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
  - 4. Type XHHW-2: Comply with UL 44.

## 2.2 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.
- C. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
  - 1. Material: Copper.
  - 2. Type: One hole with standard barrels.
  - 3. Termination: Compression.

## PART 3 - EXECUTION

## 3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- C. VFC Output Circuits Cable: Extra-flexible stranded for all sizes.
- D. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

# 3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN/THWN-2, single conductors in raceway.
- B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway
- C. Use manufacturer's approved pulling compound or lubricant where necessary. Compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values. Submit pulling schedule and calculations for verification.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- E. Exposed Branch Circuits: Type THHN/THWN-2, single conductors in raceway
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.
- G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- H. VFC Output Circuits: Type XHHW-2 in metal conduit.

## 3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

#### 3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torquetightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material.
  - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

# 3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

## 3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

## 3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

## 3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
  - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
  - 2. Perform each of the following visual and electrical tests:
    - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
    - b. Test bolted connections for high resistance using one of the following:
      - 1) A low-resistance ohmmeter.

- 2) Calibrated torque wrench.
- 3) Thermographic survey.
- c. Inspect compression-applied connectors for correct cable match and indentation.
- d. Inspect for correct identification.
- e. Inspect cable jacket and condition.
- f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
- g. Continuity test on each conductor and cable.
- h. Uniform resistance of parallel conductors.
- D. Cables will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports to record the following:
  - 1. Procedures used.
  - 2. Results that comply with requirements.
  - 3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519

#### SECTION 262923 - VARIABLE FREQUENCY DRIVES

#### PART 1 - GENERAL

#### 1.1 DESCRIPTION OF WORK

A. This section includes variable frequency drives installed as individual units as noted on the plans.

#### 1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 260519 Low Voltage Electric Power Conductor and Cables
- B. Section 400105 General Operations

#### 1.3 **REFERENCES**

- A. IEEE C62.41 (Institute of Electrical and Electronics Engineers) Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
- B. IEEE Standard 519 (Institute of Electrical and Electronics Engineers) Harmonic Limits.
- C. NEMA ICS 3.1 (National Electrical Manufacturers Association) Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems.
- D. NEMA ICS 7 (National Electrical Manufacturers Association) Industrial Control and Systems: Adjustable Speed Drives.
- E. NEMA 250 (National Electrical Manufacturers Association) Enclosures for Electrical Equipment (1000 Volts Maximum).
- F. NETA ATS (International Electrical Testing Association) Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

#### 1.4 SUBMITTALS

- A. Submittals shall be in accordance with the General Conditions. Deviations shall be clearly identified with a statement indicating the reason for the deviation.
- B. Shop Drawings: Indicate front and side views of enclosures with overall dimensions and weights shown, ventilation, conduit entrance locations and requirements, and nameplate legends.
- C. Product Data: Submit catalog sheets showing voltage, drive size, ratings and size of switching and overcurrent protective devices, short circuit ratings, control power transformer ratings, dimensions, and enclosure details.
- D. Dimensioned Layout Drawing: Submit dimensioned drawing including the proposed placement of the VFD within the electrical room demonstrating that the submitted equipment fits within the space allocated on the plans. Provide the location of the ventilation fan, ventilation intake and ventilation exhaust for each unit.

- E. Test Reports: Indicate field test and inspection procedures and test results.
- F. Manufacturer's Field Reports: Indicate start-up inspection findings.

#### 1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit instructions complying with NEMA ICS 3.1. Include procedures for starting and operating drives, and describe operating limits possibly resulting in hazardous or unsafe conditions. Include routine preventive maintenance schedule.

#### 1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with a minimum of 3-years documented experience.
- 1.7 DELIVERY, STORAGE, AND HANDLING
  - A. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.
  - B. Handle in accordance with the manufacturer's written instructions. Lift only with lugs provided. Handle carefully to avoid damage to components, enclosure, and finish.

#### 1.8 ENVIRONMENTAL REQUIREMENTS

A. Conform to NEMA ICS 7 service conditions during and after installation of variable frequency drives.

#### 1.9 WARRANTY

A. Furnish a 1-year manufacturer warranty for variable frequency drive. The VFD manufacturer shall offer extended service warranty contracts for purchase by the Owner after the startup.

#### 1.10 MAINTENANCE SERVICE

A. Furnish service and maintenance of variable frequency drive for 1 year from the date of substantial completion.

#### 1.11 MAINTENANCE MATERIALS

- A. Furnish two of each air filter, where required.
- B. Furnish two Danfoss AQUA Drive FC202 series to GWA as spare units.

#### PART 2 - PRODUCTS

- 2.1 VARIABLE FREQUENCY DRIVE
  - A. Variable Frequency Drives

Provide individual adjustable frequency drives suitable for controlling the NEMA Design B squirrel cage induction motors with the horsepower as indicated on the Drawings.

- B. Product Description: NEMA ICS 7, enclosed 6-pulse variable frequency drive, with line reactors and advanced harmonic filters (AFH) suitable for operating indicated loads. Select unspecified features and options in accordance with NEMA ICS 3.1. Drive shall be UL listed and documentation shall be provided to verify electrical system IEEE 519 compliance
- C. Ratings:
  - 1. Rated Input Voltage: 480 volts, three-phase, 60 hertz, with an available short circuit current of 42,000 amperes symmetrical.
  - 2. Motor Nameplate Voltage: 460 volts, three-phase, 60 hertz.
  - 3. Displacement Power Factor: Between 1.0 and 0.95, lagging, over entire range of operating speed and load.
  - 4. Operating Ambient:  $-10^{\circ}$ C to  $50^{\circ}$ C.
  - 5. Minimum Efficiency at Full Load: 97 percent at motor base speed and rated torque.
- D. Design Features:
  - 1. Employ microprocessor-based inverter logic isolated from power circuits.
  - 2. The drives shall utilize a full wave diode bridge rectifier to convert incoming fixed voltage and frequency to a fixed DC voltage, a filter network, and an insulated gate bipolar transistor (IGBT) inverter. The output will be sinusoidal wave, pulse width modulated (PWM) voltage waveform.
  - 3. VFD shall have input surge protection utilizing MOV's, spark gaps, and Zener diodes to withstand surges of 2.3 times line voltage for 1.3 msec.
  - 4. VFD shall include circuitry to detect phase imbalance and phase loss on the input side of the VFD.
  - 5. VFD shall include current sensors on all three-output phases to detect and report phase loss to the motor. The VFD will identify which of the output phases is low or lost.
  - 6. VFD shall auto-derate the output voltage and frequency to the motor in the presence of sustained ambient temperatures higher than the normal operating range, so as not to trip on an inverter temperature fault. The use of this feature shall be user-selectable and a warning will be exported during the event. Function shall reduce switching frequency before reducing motor speed.
  - 7. VFD shall auto-derate the output frequency by limiting the output current before allowing the VFD to trip on overload. Speed can be reduced, but not stopped.

- 8. The VFD shall have an integral RFI filter. VFD enclosures shall be made of metal to minimize RFI and provide immunity.
- 9. The output frequency drift shall be no more than plus or minus 0.5 percent of maximum frequency.
- 10. In the event of a power loss, the unit shall shut down without component failure. Upon return of utility power, the unit shall be capable of automatically returning to normal operation.
- 11. Operator interface shall be provided from a door-mounted keypad and digital display. Parameters shall be arranged in an organized format to provide ease of programming and fast access to parameters.
  - a. VFD shall provide an alphanumeric backlit display keypad, which may be remotely mounted using standard 9-pin cable. VFD may be operated with keypad disconnected or removed entirely. Keypad may be disconnected during normal operation without the need to stop the motor or disconnect power to the VFD.
  - b. VFD shall display all faults in plain text, VFD's, which can display only fault are not acceptable.
  - c. All VFD's shall be of the same series, and shall utilize a common control card and LCP (keypad/display unit) throughout the rating range. The control cards and keypads shall be interchangeable through the entire range of drives used on the project.
  - d. VFD keypad shall be capable of storing drive parameter values in nonvolatile RAM uploaded to it from the VFD, and shall be capable of downloading stored values to the VFD to facilitate programming of multiple drives in similar applications, or as a means of backing up programmed parameters.
  - e. A red FAULT light, a yellow WARNING/CALL light, and a green POWER ON/RUN light shall be provided. These indications shall be visible both on the keypad and on the VFD when the keypad is removed.
  - f. A start guide menu with factory preset typical parameters shall be provided on the VFD to facilitate commissioning.
  - g. VFD shall provide full galvanic isolation with suitable potential separation from the power sources (control, signal, power circuitry within the drive) to ensure compliance with PELV requirements and to protect PLC's and other connected equipment from power surges and spikes.
  - h. All inputs and outputs shall be optically isolated. Isolation boards between the VFD and external control devices shall not be required.
  - i. There shall be three programmable digital inputs for interfacing with the systems external control and safety interlock circuitry. An additional digital input is pre-programmed for start/stop.

- j. The VFD shall have two analog signal inputs. One dedicated for sensor input and one for external set point input.
- k. One programmable analog output shall be provided for indication of a drive status.
- 1. The VFD shall store in memory that last 5 faults with time stamp and recorded data.
- m. The VFD shall be equipped with a standard RS-485 serial communications port for communication to the multi-pump controller. The bus communication protocol for the VFD shall be the same as the controller protocol.
- 12. User adjustable functions through the operator interface shall include:
  - a. Increase or decrease output frequency.
  - b. Control mode selection (manual, off or auto).
  - c. Run and stop (manual mode operation only).
- 13. The following interface points shall be provided for operation with the PLC:
  - a. Digital Output:

Auto Status, Running, VFD Fault, High Discharge Pressure Shutdown, Low Suction Pressure Shutdown, High Motor Temperature Shutdown

- b. Digital Input: Enable
- c. Analog Output

Speed Feedback (4-20 mA) Isolated

- d. Analog Input: Speed Command (4-20 mA) Isolated
- e. Ethernet Output
- f. Door Mounted Items:
  - 1) Digital display
  - 2) HOA selector switch
  - 3) Lights: yellow = call, green = run, red = fault.
  - 4) Pushbuttons
  - 5) Elapsed Time Meter
- E. Lugs: provide lugs to accommodate the quantity and size of incoming and outgoing cables as noted on the plans.

- F. Molded case circuit breaker: Provide molded case circuit breaker within the VFD enclosure.
- G. Ventilation fan intake and exhaust shall be provided from the front of the enclosure.
- H. Safeties and Interlocks:
  - 1. Includes undervoltage release.
  - 2. Door Interlocks: Mechanical means to prevent opening of equipment with power connected, or to disconnect power when door is opened; include means for defeating interlock by qualified persons.
  - 3. Safety Interlocks: Terminals for remote contact to inhibit starting under both manual and automatic mode.
  - 4. Control Interlocks: Furnish terminals for remote contact to allow starting in automatic mode.
  - 5. Electronic Overloads and Safeties: Unit to have over and under voltage, over temperature, ground fault, overload, and over and under current stall protection.
- I. Critical Speed Lockout

The drive shall be capable of being adjusted to prevent operation at critical pump speeds.

- J. Fabrication:
  - 1. Wiring Terminations: Match conductor materials and sizes as indicated on the drawings.
  - 2. All terminals shall have terminal numbers identified. All wiring shall have wire numbers identified with wire numbers according to the schematic.
  - 3. Enclosure: NEMA 4X or IP 66, suitable for equipment application in interior locations.
  - 4. Finish: Manufacturer's standard enamel.
  - 5. Dimensions: Equipment dimensions shall not exceed those shown on the plans.
- K. Manufacturers:
  - 1. Danfoss AQUA Drive FC 202 series, no equal.
- L. Options shall include:
  - 1. Wiring Terminations Graphical Local Control Panel.
  - 2. Coated PCB Class 3c3+ruggedized.
  - 3. Main Disconnect.

- 4. 5A 24V supply + external temperature monitoring + common motor terminals.
- 5. Latest released standard software in English.
- 6. VLT Ethernet.
- 7. VLT Relay Option MCB 105

#### 2.2 SOURCE QUALITY CONTROL

- A. Shop inspect and perform standard productions tests for each drive.
- B. Inspection and test reports shall be submitted to the Construction Manager and Owner prior to shipment.

#### PART 3 - EXECUTION

#### 3.1 EXAMINATION

A. Verify building environment is maintained within service conditions required by the manufacturer.

#### 3.2 INSTALLATION

- A. Install in accordance with NEMA ICS 3.1.
- B. Tighten accessible connections and mechanical fasteners after placing drive.
- C. Install fuses in fusible switches.
- D. Select and install overload heater elements in motor drives to match installed motor characteristics.
- E. Install engraved plastic nameplates.
- F. Neatly type label inside drive door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating. Place label in clear plastic holder.
- G. Ground and bond drive in accordance with Section 260526.

#### 3.3 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4. Perform inspections and tests listed in NETA ATS, Section 7.16 and NEMA ICS 3.1.

#### 3.4 MANUFACTURER'S FIELD SERVICES

- A. Prepare and startup variable frequency drive.
- B. A start-up service technician shall be made available for start-up service, inspection, commissioning, and necessary adjustments. The start-up service technician shall be a

regular employee of the manufacturer. The start-up technician shall be made available for the duration of time necessary to correctly install and provide a complete and functioning system package for the item; a minimum of 3 days is required.

## 3.5 TRAINING

A. Furnish 8 hours of instruction to be conducted at project site with the manufacturer's representative.

#### 3.6 FUNCTIONALITY

- A. Supply complete software, interface, and cable for drive programming.
- B. VFD system shall function in accordance with in Section 400105 General Operations.

END OF SECTION 262923

# SECTION 331113 - PUBLIC WATER UTILITY DISTRIBUTION PIPING

## PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Pipe and fittings for public line, including potable water line.
  - 2. Tapping sleeves and valves.
  - 3. Underground pipe markers.
  - 4. Precast concrete vault.
  - 5. Pipe support systems.
  - 6. Bedding and cover materials.

#### B. Related Requirements:

- 1. Section 032000 Concrete Reinforcing: Reinforcing steel and required supports for castin-place concrete.
- 2. Section 033000 Cast-in-Place Concrete: Concrete for thrust restraints.
- 3. Section 310516 Aggregates for Earthwork: Aggregate for backfill in trenches.
- 4. Section 312316 Excavation: Product and execution requirements for excavation and backfill required by this Section.
- 5. Section 312317 Trenching: Execution requirements for trenching required by this Section.
- 6. Section 312323 Fill: Requirements for backfill to be placed by this Section.
- 7. Section 330513 Public Manholes and Structures: Cast-in-place, precast concrete manholes and covers, and other structure construction for access to utilities.
- 8. Section 330517 Precast Concrete Valve Vaults and Meter Boxes: Precast concrete valve vaults and meter boxes for valve and meter installation.
- 9. Section 331300 Disinfecting of Water Utility Distribution: Disinfection of water piping.
- 10. Section 400501 Piping, General
- 11. Section 400525 Mill Piping
- 12. Section 400566 Valves, Gauges and Appurtenances

#### 1.2 REFERENCE STANDARDS

- A. American Association of State Highway and Transportation Officials:
  - 1. AASHTO T 180 Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

#### B. American Society of Mechanical Engineers:

1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.

#### C. ASTM International:

- 1. ASTM A36 Standard Specification for Carbon Structural Steel.
- 2. ASTM A36M Standard Specification for Carbon Structural Steel.
- 3. ASTM A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- 4. ASTM A123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- 5. ASTM A307 Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.
- 6. ASTM D698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft3 (600 kN-m/m3).
- 7. ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3).
- 8. ASTM D1785 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- 9. ASTM D2241 Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
- 10. ASTM D3035 Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
- 11. ASTM D3139 Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
- 12. ASTM D6938 Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
- 13. ASTM F477 Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
- D. American Water Works Association:
  - 1. AWWA C104 Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
  - 2. AWWA C105 Polyethylene Encasement for Ductile-Iron Pipe Systems.
  - 3. AWWA C110 Ductile-Iron and Gray-Iron Fittings.
  - 4. AWWA C111 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
  - 5. AWWA C115 Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
  - 6. AWWA C151 Ductile-Iron Pipe, Centrifugally Cast.
  - 7. AWWA C153 Ductile-Iron Compact Fittings.
  - 8. AWWA C200 Steel Water Pipe, 6 In. (150 mm) and Larger.
  - 9. AWWA C203 Coal-Tar Protective Coatings and Linings for Steel Water Pipelines Enamel and Tape Hot-Applied.
  - 10. AWWA C205 Cement-Mortar Protective Lining and Coating for Steel Water Pipe 4 In. (100 mm) and Larger Shop Applied.
  - 11. AWWA C206 Field Welding of Steel Water Pipe.
  - 12. AWWA C207 Steel Pipe Flanges for Waterworks Service Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm).
  - 13. AWWA C208 Dimensions for Fabricated Steel Water Pipe Fittings.
  - 14. AWWA C213 Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
  - 15. AWWA C500 Metal-Seated Gate Valves for Water Supply Service.
  - 16. AWWA C509 Resilient-Seated Gate Valves for Water Supply Service.

- 17. AWWA C600 Installation of Ductile-Iron Mains and Their Appurtenances.
- 18. AWWA C605 Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.
- 19. AWWA C606 Grooved and Shouldered Joints.
- 20. AWWA C900 Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In., for Water Transmission and Distribution.
- 21. AWWA M6 Water Meters Selection, Installation, Testing, and Maintenance.
- E. Manufacturers Standardization Society of the Valve and Fittings Industry:
  - 1. MSS SP-60 Connecting Flange Joints between Tapping Sleeves and Tapping Valves.

# 1.3 SUBMITTALS

- A. Section 013300 Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit data on pipe materials, pipe fittings, valves, and accessories.
- C. Shop Drawings: In addition to the requirements specified in individual piping sections in Division 33, Shop Drawings shall contain the following information:
  - 1. Layout Drawings: Line layout and marking diagrams shall indicate the following information:
    - a. The specific number of each pipe and fitting and location of each pipe and the direction of each fitting in the completed line. In addition, the line layouts shall include:
      - 1) Pipe station and invert elevation at all changes in grade or horizontal alignment;
      - 2) Station and invert elevation to which the bell end of each pipe will be laid;
      - 3) All elements of curves and bends, both in horizontal and vertical alignment;
      - 4) Limits of each reach of restrained and/or welded joints, or of concrete encasement; and
      - 5) All necessary dimensions, details, pipe joints, fittings, specials, valves, manholes, vaults, appurtenances, anchors, supports, and couplings.
    - b. Fabrication drawings shall indicate all spool pieces, adapters, connectors, fittings, encasements, and supports to accommodate the pipeline in a complete and functional system.
  - 2. Shop drawings and design calculations for joint restraint systems.

- 3. Proposed temporary bypass piping systems:
  - a. Catalog data for pipe material
  - b. Working drawings and description of sizes and locations
- 4. Tapping Sleeve and Valve or Tapping Assembly and Valve: Submit before main is tapped.
  - a. Install and testing instructions.
  - b. Recommended maximum test pressure and length of time for testing assembly using water as test medium.

#### D. Certificate:

- 1. Certify that products meet or exceed specified requirements.
- 2. All necessary certificates, test reports, and affidavits of compliance shall be obtained by the Contractor and provided to Owner.
- 3. Manufacturer's Statement: A statement for the pipe manufacturer certifying that all pipes will be manufactured subject to a recognized Quality Control Program. An outline of the program shall be submitted to the Construction Manager for review prior to manufacturing any pipe.
- 4. Evidence of compliance with ANSI/NSF 61 and ANSI/NSF 372 provided by an accredited third, such as NSF, UL, or approved equivalent, for all components in contact with potable water.
- E. Samples: All expenses incurred in making samples for certification of tests shall be borne by the Contractor at no additional cost to GWA.
- F. Qualifications of the Tapping Specialist: The Contractor shall furnish a tapping specialist to perform actual tapping operation and submit a list of at least 2 projects of similar size, type, and complexity in tapping completed by the tapping specialist in the last 5 years.

## 1.4 CLOSEOUT SUBMITTALS

- A. Section 017000 Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of piping mains, valves, connections, thrust restraints, and invert elevations.
- C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.
# 1.5 QUALITY ASSURANCE

A. Perform Work according to GWA standards and in accordance with the Contract Documents.

# 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Block individual and stockpiled pipe lengths to prevent moving.
- C. Do not place pipe or pipe materials on private property or in areas obstructing pedestrian or vehicle traffic.
- D. Store polyethylene and PVC materials out of sunlight.

# 1.7 EXISTING CONDITIONS

- A. Field Measurements:
  - 1. Verify field measurements prior to fabrication.
  - 2. Indicate field measurements on Shop Drawings.

# PART 2 - PRODUCTS

# 2.1 WATER PIPING

- A. Ductile-Iron Pipe:
  - 1. Comply with AWWA C151 and requirements of Section 400501 Piping, General.
  - 2. Bituminous Outside Coating: Comply with AWWA C151.
  - 3. Pipe Mortar Lining:
    - a. Comply with AWWA C104.
    - b. Double thickness.
  - 4. Polyethylene Encasement: Comply with AWWA C105, 8-mil Linear Low-Density polyethylene film.
  - 5. Pipe Class:
    - a. Comply with AWWA C151.
  - 6. Fittings:
    - a. Material: Ductile iron, AWWA C110.
    - b. Compact Fittings: Comply with AWWA C153.
    - c. Coating and Lining:

- 1) AWWA C116/A21.16, fusion-bonded epoxy coatings on exterior and interior surfaces.
- 7. Joints:
  - a. Mechanical and Push-on Joints: Comply with AWWA C111.
  - b. Flanged Joints: Comply with AWWA C115.
  - c. Restrained Joints: joint restraint independent of joint seal.
- B. PVC Pipe:
  - 1. Polyvinyl Chloride (PVC) Plastic Water Main Pipe and Associated Fittings: Pipe shall conform to AWWA C900, Pressure Class 235 (DR 18), and will be either plain end or gasket bell end with cast-iron-pipe-equivalent OD. Fittings shall conform to AWWA C110 or AWWA C153, gray-iron or ductile-iron with a pressure rating not less than that of the pipe. Fittings shall have AWWA C116/A21.16, fusion-bonded epoxy coatings on exterior and interior surfaces.
  - 2. Joints for PVC pipe shall be push-on joints conforming to ASTM D3139 or compression-type mechanical joints conforming to ASTM D3139 and AWWA C111. Provide ASTM F477 gaskets for push-on joints for pipe and AWWA C111 gaskets for push-on joints and mechanical joints for joint connections between pipe and metal fittings, valves and other accessories.
  - 3. Connectors:
    - a. Flexible Couplings: Provide flexible couplings where called for on the drawings or where necessary in sizes and working pressure equal to the design pressure for the pipe for which they are to be installed. For buried pipes, they shall have cast-iron sleeves with flange and bolts of high-strength ductile iron. Gaskets shall be neoprene or natural rubber.
    - b. Transition Couplings shall be of ductile iron, meeting or exceed the requirements of ASTM A536, Grade 65. Gaskets shall be virgin SBR compounded for water in accordance with ASTM D2000 MBA 710. Bolts and nuts shall be high strength, low alloy steel trackhead bolts. National coarse rolled thread and heavy hex nuts. Steel meets AWWA C111 composition specifications. Coatings shall be fusion bonded or liquid epoxy.
    - c. Where flexible couplings are used as expansion joints, the ends of the pipes shall be separated 1 inch to allow for expansion. Couplings shall be centered on pipe ends. Runs of pipe containing flexible couplings shall be properly blocked, anchored or tied to the structure to prevent joints from pulling apart.
    - d. Flanged Coupling Adapters: Flanged adapters shall have at least four (4) anchor studs per coupling or equivalent. Bolts and nuts shall be Type 18-8 stainless steel.
    - e. Clamp-Type Couplings: Clamp-type couplings shall be designed for a water working pressure equal to the design pressure for the pipe on which they are to be installed, and shall be equipped with rubber gaskets for water service. Band shall be Stainless Steel Type 304 with high strength malleable iron ASTM A47 Grade 32510 or ductile iron ASTM A536 lugs.
    - f. Insulating Flanges: Insulating flanges shall be used with couplings to connect pipes of dissimilar material or when indicated on the drawings. The insulating

flanges shall consist of a central gasket, bolt sleeve and insulating washer with steel washers. The central gasket shall be glass reinforced. The insulating flanges shall be designed to operate at the ASA rating of the flange on which installed.

g. Bolts and Nuts: Unless otherwise specified elsewhere, all bolts, washers, and nuts not specified to be Type 18-8 stainless steel. The material for steel bolts and nuts shall conform to the requirements of the current ASTM A 325. If washers are used, they shall be of forged or rolled steel. All bolts shall be furnished with hexagonal or square heads and semi-finished hexagonal nuts. The dimensions of all heads and nuts shall be not less than those required for the American Standard regular, and the height shall be sufficient to break the bolt in the body portion when tested. Threads shall be American Standard Screw Thread, coarse thread series.

# 2.2 TAPPING SLEEVES AND VALVES

- A. Tapping Sleeves:
  - 1. Manufacturers:
    - a. Smith-Blair, Inc.
    - b. Romac Industries, Inc.
    - c. Ford Meter Box Company, Inc.
    - d. Or Approved Equal
  - 2. Description:
    - a. The Contractor shall furnish and install tapping sleeves, as shown on the Drawings. All items not specifically mentioned in these specifications or noted on the Drawings, but which can be reasonably inferred as necessary to make a complete working installation, shall be included.
    - b. Tapping sleeves, where indicated, shall fit the existing pipe to be tapped. The Contractor shall determine the outside diameter and type of pipe before ordering the sleeve by field verification of dimensions as actual locations, distances, and levels will be governed by actual locations. The Contractor shall adjust his work to conform to said field conditions.
    - c. Tapping sleeves shall meet the requirements of AWWA C223 and MSS SP-60 and shall be utilized only for live tap applications where indicated. No taps (all sizes) shall be made within 5 pipe diameters or 5 feet (whichever is smaller) of a joint. For size-on-size taps, on 8-inch and larger pipes, the actual hole size shall be reduced by 1-inch. Tapping sleeves 8-inch and smaller may have outlet connections to fit a mechanical joint tapping valve.
      - Stainless steel tapping sleeves: Stainless steel tapping sleeves shall be used for 4-inch through 12-inch diameter main pipe unless otherwise indicated. Stainless steel tapping sleeves shall be 304 stainless steel, including flanges. All welds shall conform to ASTM A380 and shall be fully passivated.

- 2) Carbon steel tapping sleeves: Fabricated steel tapping sleeves shall be used on 14-inch and larger diameter main pipe where indicated. The sleeve body and straps shall be carbon steel, ASTM A36 or ASTM Grade C, fusion-bonded epoxy coated to minimum 12-mil dry film thickness (DFT) in accordance with AWWA C213.
- d. All sleeves shall be provided with Type 304 stainless steel studs and nuts. Nuts shall be coated with fluoropolymer coating to prevent galling.
- e. Tapping sleeves shall have a pilot flange recessed for tapping per MSS SP-60. The pilot flange shall be rated Class D according to AWWA C207 with 150 pound drilling according to ANSI B 16.5. Each sleeve shall be supplied with a flanged gasket bonded to the flange. Gaskets shall be of Buna-N or Buna-S wedge type.
- f. The body gasket shall be full circle, grid pattern, converting the entire length of the sleeve, cloth reinforced with attached stainless steel bridge to support the gasket at the lugs. The gasket shall be made of SBR rubber or similar material, suitable for use with water and sewage.
- g. All sleeves shall have <sup>3</sup>/<sub>4</sub>-inch NPT (minimum) Type 304 stainless steel test plug. Tapping sleeves for concrete pipe shall be equipped with SBR neck gaskets, grout horns, and foam grout seal.
- h. All sleeves shall be rated for 150 psi minimum operating pressure and 200 psi minimum test pressure unless otherwise indicated.
- B. Tapping Valves:
  - 1. Manufacturers:
    - a. American Cast Iron Pipe Co.
    - b. Mueller Company
    - c. Or Approved Equal
  - 2. Description:
    - a. Comply with AWWA C500.
    - b. Type: Double disc with non-rising stem.
    - c. Inlet Flanges: Comply with ASME B16.1, Class 125 and MSS SP-60.

# 2.3 VALVES

A. As specified in Section <del>331216</del> Water Utility Distribution Valves<u>400566</u> – Valves, Gauges, and Appurtenances.

# 2.4 AIR RELEASE VALVES, AIR/VACUUM, AND COMBINATION AIR VALVES

A. As specified in Section 400566 – Valves, Gauges and Appurtenances.

# 2.5 UNDERGROUND PIPE MARKERS

- A. Plastic Ribbon Tape:
  - 1. Brightly colored, continuously printed.
  - 2. Minimum 6 inches wide by 4 mil thick.
  - 3. Manufactured for direct burial service.
  - 4. Conform to GWA Standards
- B. Trace Wire:
  - 1. Electronic detection materials for nonconductive piping products.
  - 2. Unshielded, 10 AWG, THWN-insulated copper wire.
  - 3. Conductive tape.

# 2.6 PRECAST CONCRETE VALVE VAULTS AND METER BOXES

A. Precast Concrete Valve Vaults and Meter Boxes: As indicated on Drawings.

# 2.7 VALVE BOXES

- A. Manufacturers:
  - 1. Long Beach Iron Works
  - 2. Neenah Foundry
  - 3. Alhambra Foundry
  - 4. Or Approved Equal
- B. Description: Valve boxes conforming to GWA Standard Details W-150 & W-160 shall be provided. For gate valves greater than 12-inches Alhambra Foundry Company A-3005 or A-3007 cast iron valve extension boxes, or approved equal, shall be used.
- C. Type: Cast iron;, manufactured of clean, even grain, gray cast iron conforming to ASTM Designation A48, Gray Iron Castings, smooth, true to pattern, free from blow holes, sand holes, projections, or other harmful defects and shall be coated in accordance with 099000 Painting and Coating.
- D. Valve box extension shall be constructed of 8" diameter PVC C-900 pipe, and shall be properly supported apart from the valve.
- E. Covers: Marked WATER, or as approved by GWA.
- F. Tag: Brass identification tag, two (2) inch diameter by 1/8" thick with <sup>1</sup>/4" hole, indicating valve size, valve type, direction and number of turns to open. Attach tag to end of locating wire, or inside of the cast iron valve cover, using <sup>1</sup>/<sub>4</sub>" hole in tag.

# 2.8 PIPE SUPPORTS AND ANCHORING

- A. Metal for Pipe Support Brackets: Structural steel, thoroughly coated with bituminous paint.
- B. Metal Tie Rods and Clamps or Lugs: Galvanized steel sized according to NFPA 24, thoroughly coated with bituminous paint.

# 2.9 CONCRETE ENCASEMENT AND CRADLES

- A. Concrete:
  - 1. As specified in Section 033000 Cast-in-Place Concrete.
  - 2. Compressive Strength: 2,500 psi, minimum, at 28 days.
  - 3. Finish: Rough troweled.
- B. Concrete Reinforcement: As specified in Section 032000 Concrete Reinforcing.

# 2.10 PIPE BEDDING AND COVER MATERIALS

- A. Bedding and Cover:
  - 1. As specified in Section 312323.13 Fill.

#### 2.11 FINISHES

A. Steel: Hot-dip galvanized after fabrication, according to ASTM A123.

#### 2.12 ACCESSORIES

- A. Concrete for Thrust Restraints: As specified in Section 033000 Cast-in-Place Concrete.
- B. Steel Rods, Bolt, Lugs, and Brackets:
  - 1. Comply with ASTM A36 or ASTM A307.
  - 2. Grade A carbon steel.
- C. Protective Coating: Coal tar.
- 2.13 FLEXIBLE EXPANSION JOINTS (FLEX JOINTS)
  - 1. Flexible expansion joints shall be manufactured of ductile iron conforming to the material requirements of ASTM A536 and ANSI/AWWA C153/A21.53. Foundry certification of material shall be readily available upon request.

- 2. Each flexible expansion joint shall be pressure tested prior to shipment against its own restraint to a minimum of 350 psi. A minimum 2:1 safety factor, determined from the published pressure rating, shall apply. Factory Mutual Approval for the 3 inch through 12 inch sizes is required.
- 3. Each flexible expansion joint shall consist of an expansion joint designed and cast as an integral part of a ball and socket type flexible joint, having a minimum per ball deflection of: 20°, 2" 12"; 15°, 14" 36"; and 8-inches minimum expansion. Additional expansion sleeves shall be available and easily added or removed at the factory or in the field. Both standardized mechanical joint and flange end connections shall be available.
- 4. All internal surfaces (wetted parts) shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213. Sealing gaskets shall be constructed of EPDM. The coating shall meet ANSI/NSF-61.
- 5. Exterior surfaces shall be coated with a minimum of 6 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C116/A21.16.
- 6. Appropriately sized polyethylene sleeves, meeting ANSI/AWWA C105/A21.5, shall be included for direct buried applications.
- Manufacturer's certification of compliance to the above standards and requirements shall be readily available upon request. The purchaser (or owner) shall reserve the right to inspect the manufacturer's facility for compliance. All flexible expansion joints shall be manufactured in the USA. FLEX-TEND as manufactured by EBAA Iron, FJ Restraint as manufactured by Romac, or approved equal.

# PART 3 - EXECUTION

# 3.1 EXAMINATION

- A. Section 017000 Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that existing utility water main size, location, and invert are as indicated on Drawings.

# 3.2 PRODUT DELIVERY, STORAGE, AND HANDLING

- A. Delivery of Materials: Products shall be delivered in original, unbroken packages, containers, or bundles bearing the name of the manufacturer. Materials delivered onsite without an approved submittal for verification shall be rejected and payment withheld.
- B. Storage: Products shall be carefully stored in a manner that will prevent damage and in an area that is protected from the elements.

# 3.3 PREPARATION

- A. Section 017000 Execution and Closeout Requirements: Requirements for installation preparation.
- B. Preparation:
  - 1. Utility Relocation: Notify the Construction Manager of the existing utilities owned by public utility or franchise holders, which must be relocated, and allow reasonable time for doing so. GWA will contact the utility or franchise holder and request relocation. Relocation and protection of existing utilities which are the Contractor's responsibility shall be performed at no additional cost to Owner.
  - 2. Before submitting joint shop drawings, where the proposed piping will connect to existing piping, the Contractor shall excavate the point of connection to verify size, layout, and depth. Prepare a sketch of the proposed point of connection for submittal with the joint shop drawings. The Contractor shall give the Construction Manager a minimum of 48 hours' notice to inspect the existing piping before backfilling.
- C. Dewatering:
  - 1. Install and operate according to Paragraph 3.2 K in Section 312316 Excavation a continuous dewatering system capable of maintaining the ground water or perched water level two (2) feet below the excavated trench bottom if groundwater or perched water is encountered during the Work. Only well points located on both sides of the trench shall be used for dewatering, unless otherwise approved by the Construction Manager.
  - 2. Operate the dewatering system seven (7) days per week, 24 hours per day with water level as indicated above until backfilling is completed.
  - 3. Field-determined departures from the dewatering plans may necessitate adjustments to the trench shoring and bracing methods to achieve soil stability. Adjustment shall be at no additional cost to Owner.
  - 4. Dewatering shall prevent softening of the bottom of excavations or formation of quick conditions. Dewatering shall not remove native soils. All loose soil shall be removed and re-compacted in accordance with Section 312316.13 Trenching.
- D. Excavation:
  - 1. Unless indicated otherwise, excavation and over-excavation shall be in accordance with Section 312316.13 Trenching.
  - 2. Trench width shall be as indicated.
  - 3. Stabilize the trench subgrade by compaction to 95% maximum dry density. Where trench bottom has been over-excavated, compact the bedding to 95% in 1-foot thick layers.
- E. Layout and Handling:
  - 1. Handling of Pipe and Accessories: Pipe shall be lifted in such a manner as to minimize bending and prevent damage to the pipe. During transport, pipe shall be supported to prevent distortion or damage to the pipe. When not being handled, pipe shall be stockpiled on timber cradles or properly prepared ground with all rocks larger than 3 inches eliminated. All pipe, fittings, valves and accessories shall be carefully lowered into the trench in such a manner as to prevent damage to pipe and fittings. Under no circumstances shall pipe or accessories be dropped or dumped into the trench. The Contractor shall smooth out any burrs, gouges, or weld splatter and repair other defects

prior to laying the pipe. Any pipe section, including coatings and linings, that becomes damaged as a result of handling or stockpiling shall be replaced with a new unit or repaired at the discretion of the Construction Manager at no additional cost to Owner

# 3.4 INSTALLATION

- A. Interferences:
  - 1. Contractor shall protect and maintain all underground and surface utility structures, drains, sewers, and other obstructions encountered in the progress of the Work. Where indicated that the grade or alignment of the pipe is obstructed by existing utility structures such as conduits, ducts, or pipes, the obstruction shall be supported until it is relocated, removed, or reconstructed by the Contractor in cooperation with the owner of such utility structures. Unless otherwise indicated, this Work shall be performed at no additional cost to Owner.
  - 2. Where necessary to raise or lower the pipe due to unforeseen obstructions or other causes, the Construction Manager may direct a change in the alignment or the grades. Such change shall be made by the deflection of joints, by the use of bevel adapters, or by the use of additional fittings. However, in no case shall the deflection in the joint exceed the maximum deflection recommended by the pipe manufacturer. No joint shall be misfit any amount which will be detrimental to the strength and integrity of the finished joint.
- B. Line and Grade Tolerance: Each section of pipe shall be laid in the order and position shown on the laying schedule. Unless indicated otherwise, the pipe shall be laid to the design line and grade, within approximately one inch plus or minus. Straight slopes shall be maintained between inverts indicated on the Drawings. No tolerance is permitted on pipes designed for zero slope.
- C. **Curved Alignments**: Where curved alignments are indicated, deflecting the joints will be allowed only in accordance with the written instructions of the pipe manufacturer and these specifications. Where a smaller radius of curvature is required than can be accommodated by deflecting the joints, sections of pipe with beveled ends may be laid unless fabricated bends are indicated. Maximum joint deflection and maximum bevel for different pipe sizes and joint designs shall be in accordance with the pipe manufacturer's recommendations and these specifications.
- D. Cutting and machining of the pipe shall only be in accordance with the pipe manufacturer's standard procedures for this operation. Pipe shall not be cut with a cold chisel, standard iron pipe cutter, or any other method that may fracture the pipe, produce ragged, uneven edges, or otherwise impair the condition of the pipe.
- E. The Contractor shall provide and install all pipe, fittings, closure pieces, bends, reducers, wyes, tees, crosses, outlets, manifolds, and other steel plate specials, bolts, nuts, gaskets, jointing materials, and all other appurtenances as indicated and as required to provide a complete and workable installation.
- F. No pipe or appurtenance shall be installed when the interior or exterior surfaces show cracks or other defects that may be harmful as determined by the Construction Manager. Damaged

interior and exterior surfaces shall be repaired to the satisfaction of the Construction Manager or a new undamaged pipe or appurtenance shall be provided.

- G. Pipe laying operations shall be stopped and dewatering operations shall be adjusted to prevent the pipe from floating due to water entering the trench from any source. The Contractor shall reinstall all affected pipe to its specified condition and grade.
- H. All foreign matter or dirt shall be removed from the interior of the pipe before lowering into position in the trench. Pipe shall be kept clean during and after laying. All openings in the pipe line shall be closed with water tight expandable type sewer plugs or PVC test plugs at the end of each day's operation or whenever the pipe openings are left unattended. The use of burlap, wood, or other similar temporary plugs will not be permitted.
- I. Immediately before placing each section of pipe in final position for jointing, the bedding shall be checked for firmness and uniformity of surface. No pipe shall be installed on fill material without first meeting in-place density test requirements in accordance with Section 312316.13 Trenching.
- J. Except for short runs which may be permitted by the Construction Manager, sections of pipe shall be laid in a sequence moving in an upgrade direction on grades exceeding 10 percent. Pipe which is laid in a downgrade direction shall be blocked and held in place until sufficient support is furnished by the following pipes to prevent movement.
- K. Pipe shall be laid directly on the bedding material. No blocking will be permitted and the bedding shall form a continuous, solid bearing for the full length of the pipe. Excavate to facilitate removal of handling devices after the pipe is laid. Bell holes shall be formed at the ends of the pipe to prevent point loading at the bells or couplings and to facilitate placement of grout bands. Excavation shall be adequate to permit access to the joints for bonding operations and for application of coating on field joints.
- L. Bedding:
  - 1. Excavation:
    - a. Excavate pipe trench as specified in Section 312316.13 Trenching for Work of this Section.
    - b. Hand trim excavation for accurate placement of pipe to elevations as required, or as indicated on Drawings.
  - 2. Dewater excavations to maintain dry conditions and to preserve final grades at bottom of excavation.
  - 3. Provide sheeting and shoring as specified in Section 312316.13 Trenching.
  - 4. Place bedding material at trench bottom, level fill materials in one continuous layer not exceeding 6 inches compacted depth, and compact to 95 percent of maximum density.
- M. Piping:
  - 1. Install pipe according to AWWA C600 or AWWA C605, as appropriate for type of pipe.
  - 2. Handle and assemble pipe according to manufacturer instructions and as indicated on Drawings.

- 3. Steel Rods, Bolt, Lugs, and Brackets: Coat buried steel with one coat of coal tar coating before backfilling.
- 4. High Points:
  - a. Install pipe with no high points, unless otherwise indicated.
  - b. If unforeseen field conditions arise that necessitate high points, install air release valves as directed by Construction Manager.
- 5. Bearing:
  - a. Install pipe to have bearing along entire length of pipe.
  - b. Excavate bell holes to permit proper joint installation.
  - c. Do not lay pipe in wet trench.
- 6. Prevent foreign material from entering pipe during placement.
- 7. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- 8. Close pipe openings with watertight plugs during Work stoppages.
- 9. Install access fittings to permit disinfection of water system performed under Section 331300 Disinfecting of Water Utility Distribution.
- 10. Cover:
  - a. Establish elevations of buried piping with not less than 3 feet of cover, unless otherwise indicated or approved.
  - b. Measure depth of cover from final surface grade to top of pipe barrel.
- 11. Pipe Markers:
  - a. Install plastic ribbon tape continuous buried 18 inches below finish grade, above piping.
  - b. Coordinate with trench Work as specified in Section 312316.13 Trenching.
- N. Valves:
  - 1. Install valves as specified in Section 400566 Valves, Gauges and Appurtenances.
- O. Tapping Sleeves and Valves:
  - 1. As indicated on Drawings and according to manufacturer instructions.
- P. Polyethylene Encasement:
  - 1. Encase all metallic piping and/or fittings in 8-mil LLD polyethylene to prevent contact with surrounding backfill material.
  - 2. Polyethylene encasement shall be installed by personnel trained or experienced in the proper application of encasement as described in AWWA C105. At all times during construction of the pipeline, precautions shall be taken to prevent damage to the encasement film.
  - 3. Comply with AWWA C105.
  - 4. Terminate encasement 3 to 6 inches above ground where pipe is exposed.

- Q. Thrust Restraints:
  - 1. Provide valves, tees, bends, caps, and plugs with concrete thrust blocks.
  - 2. Pour concrete thrust blocks against undisturbed earth.
  - Locate thrust blocks at each elbow or change of pipe direction to resist resultant force and to ensure that pipe and fitting joints will be accessible for repair.
  - 3. Install tie rods, clamps, setscrew retainer glands, or restrained joints.
  - 4. Protect metal-restrained joint components against corrosion by applying a bituminous coating or encasing metal area using concrete mortar.
  - 5. Do not encase pipe and fitting joints to flanges.
  - 6. Install thrust blocks, tie rods, and joint restraint at dead ends of water main.
- R. Flexible Expansion Joints (Flex Joints):
  - 1. Install per manufacturer's instructions. Each installation shall be inspected and approved by the Construction Manager.
- S. Backfilling: Backfill around sides and to top of pipe as specified in Section 312316.13 Trenching.
- T. Valve Covers:
  - 1. Provide reinforced concrete collar as indicated in GWA Std Detail W-150.
  - 2. The base shall be carefully centered over the valve operator and shall be on line with nut at top of valve stem and the entire assembly shall be plumb. Any valve box that is out of alignment or whose top does not conform to finish grade shall be dug out and reset.
  - 3. The valve box shall not transmit surface loads to the pipe or valve.
  - 4. Care shall be taken to prevent earth or other material from entering the valve box.
  - 5. The cover shall not rock after it has been seated in any position in its associated jacket.
  - 6. The concrete collar shall be placed on firm compacted subgrade. The top of the concrete pad shall be level with the top of the cast iron valve box and level with grade. The required brass valve identification tag shall be attached to the tracer wire, or to the inside of the cast iron valve cover.
  - 7. Valves buried 60" or deeper, shall be provided with operating risers to ensure the operating nut is 36 inches, or less, from the ground surface.
- U. Disinfection of Potable Water Piping System:
  - 1. As specified in Section 331300 Disinfecting of Water Utility Distribution.

# 3.5 TOLERANCES

A. Install pipe to indicated elevation within tolerance of 5/8 inch.

# 3.6 CORROSION CONTROL

A. **Insulating Bushings and Unions**: Pipe or fittings made of nonferrous metals shall be isolated from ferrous metals by nylon insulating pipe bushings, unions or couplings.

B. **Joint Bonding**: Where shown, pipe joints shall be bonded in accordance with the details indicated. The Contractor shall furnish all materials required for joint bonding and test station installations. The pipe shall be cleaned to bare bright metal at the point where the bond is installed. The pipe manufacturer shall be responsible for determining and implementing a suitable procedure and schedule for installation of bonding (field versus factory versus combination) in such a manner that the corrosion resistance of the lining and coating is not degraded by the bonding process. It may involve welding joint bonding pads, or welding the bonding wires in the factory before applying the lining and coating specified and/or may involve patching impaired areas in the factory or the field.

To accommodate attachment of the joint bonding pad, which is used to eliminate damage to the interior pipe lining during the alumino-thermal welding,  $2\frac{1}{2}$ -inch × 2-inch ×  $\frac{3}{8}$ -inch thick pads of the same metal as the pipe shall be welded on both ends of the pipe prior to lining and coating. The Contractor shall use the proper size of alumino-thermal welding charge for installing the joint bonding wires.

C. Insulated joints shall be installed where shown. The Contractor shall exercise special care when installing these joints to prevent electrical conductivity across the joint. After the insulated joint is completed, an electrical resistance test will be performed by the Construction Manager. Should the resistance test indicate a short circuit, the Contractor shall remove the insulating units to inspect for damages, replace all damaged portions and reassemble the insulating joint. The insulated joint shall then be retested to assure proper insulation.

# 3.7 FIELD QUALITY CONTROL

- A. Pressure test system according to AWWA C600 and following:
  - 1. Test Pressure: Not less than 200 psig or 50 psi in excess of maximum static pressure, whichever is greater.
  - 2. Conduct hydrostatic test for at least two hours.
  - 3. Slowly fill section to be tested with water; expel air from piping at high points. Install corporation cocks at high points. Close air vents and corporation cocks after air is expelled. Raise pressure to specified test pressure.
  - 4. Observe joints, fittings, and valves under test. Remove and renew cracked pipes, joints, fittings, and valves showing visible leakage. Retest.
  - 5. Correct visible deficiencies and continue testing at same test pressure for additional two hours to determine leakage rate. Maintain pressure within plus or minus 5 psi of test pressure. Leakage is defined as quantity of water supplied to piping necessary to maintain test pressure during period of test.
  - 6. Compute maximum allowable leakage using following formula:
    - a. L = SD x sqrt(P)/C.
      - 1) L = testing allowance, gph.
      - 2) S =length of pipe tested, feet.
      - 3) D = nominal diameter of pipe, inches.
      - 4) P = average test pressure during hydrostatic test, psig.
      - 5) C = 148,000.

- b. If pipe under test contains sections of various diameters, calculate allowable leakage from sum of computed leakage for each size.
- 7. Leakage:
  - a. If test of pipe indicates leakage greater than allowed, locate source of leakage, make corrections, and retest until leakage is within allowable limits.
  - b. Correct visible leaks regardless of quantity of leakage.
- B. Compaction Testing for Bedding: Comply with ASTM D1557.
- C. If tests indicate Work does not meet specified requirements, remove Work, replace, and retest.
- D. Frequency of Compaction Tests: 1 test per lift per 300 linear feet of trench.

# END OF SECTION 331113

# SECTION 400570 – PRESSURE REDUCING AND PRESSURE SUSTAINING VALVES

# PART 1 - GENERAL

# 1.1 SUMMARY

- A. Under this specification, the Contractor shall furnish, deliver, unload, install and adjust, within the time specified, the combination pressure reducing and pressure sustaining valves (PRSV's) as specified on the Drawings and hereinafter described in these Specifications.
- B. The valve manufacturer shall be able to supply a complete line of equipment from 2-inch through 24-inch sizes and a complete selection of complimentary equipment. The valve manufacturer shall also provide a computerized cavitation chart to which show flow rate, differential pressure, percentage of valve opening, Cv factor, system velocity, and indicate if there will be a potential for damages due to cavitation.
- C. A start-up service technician shall be made available for start-up service, inspection, commissioning, and necessary adjustments. The start-up service technician shall be a regular employee of the valve manufacturer. The start-up service technician shall be made available for the duration of time necessary to correctly install and provide a complete and functioning system package for the item; a minimum of 3 days is required. Provide 1 full day of training at job site(s) for GWA operations personnel.
- D. Start-up service to include 3 bound O&M manuals and 3 electronic discs containing the O&M. O&M manuals should be submitted for review and accepted a minimum of three (3) weeks prior to start-up services.
- E. Wetted surfaces of valves, trim, accessories, coatings, etc. intended for use on potable and domestic water systems shall be NSF-61 and NSF-372 certified.

#### 1.2 SUBMITTALS

A. Submit to Engineer for approval, shop drawings, technical information, and manufacturer's order form on completed valve assembly including all options, appurtenances and cavitation report.

# PART 2 - PRODUCT

# 2.1 GENERAL

- A. The valve shall have an ASTM A536 ductile iron body and cover, ANSI B16.42 Class 150 flanges, and be a flanged combination pressure reducing & sustaining valve. The valve shall be equipped with features to control the speed of opening and closing of the valve.
- B. The valve shall have a fusion-bonded epoxy lined and coated ductile iron body with 316 stainless steel trim, and 316 stainless steel pilots and pilot tubing. The spring provided with the valve shall have an adjustment range suitable for maintaining a downstream pressure as indicated on the project drawings. The valve shall be Cla-Val Model 92-01 Pressure Reducing & Sustaining Valve, or approved equal. For each PRSV, provide:

- 1. CK2 isolation valves
- 2. Inlet and outlet X141 pressure gauges
- 3. CV flow (speed) control (closing)
- 4. X101 valve position indicator
- 5. CRD Pressure Reducing Pilot Control, with range as indicated on plans for each location
- 6. CRL-60 Pressure Relief Pilot Control, range: 20 to 200 psi
- 7. Where indicated on plans, X144 e-FlowMeter sized appropriately for each PRSV, with X145 e-Display.

All components listed above are Cla-Val model numbers. Approved equals are acceptable. All components shall be manufactured by the PRSV manufacturer.

# 2.2 FUNCTION

A. The valve shall be fully hydraulic, and shall automatically reduce a higher inlet pressure to a steady lower downstream pressure, regardless of changing flow rate and/or varying inlet pressure, and sustain the upstream pressure to a pre-determined minimum. If downstream pressure exceeds the pressure setting of the control pilot, the main valve and pilot close drip-tight. The pressure sustaining control is normally held open by the upstream pressure, but modulates should the pressure drop to the control set point. This, in turn, modulates the main valve to sustain the desired upstream pressure.

# 2.3 MAIN VALVE

A. The valve shall be hydraulically operated, single diaphragm-actuated, globe pattern. The valve shall consist of three major components: the body with seat installed, the cover with bearings installed, and the 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 pistons operating the main valve or pilot controls.

# 2.4 MAIN VALVE BODY

- A. No separate chambers shall be allowed between the main valve cover and body. Valve body and cover shall be of cast ductile iron. No fabrication or welding shall be used in the manufacturing process.
- B. 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. The disc guide, seat and covering bearing shall be constructed of 316 stainless steel. 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. Disc retainer shall be cast iron, and disc material shall be EPDM rubber.

- C. 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.
- D. 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 open or fully closed position. Diaphragm washer shall be cast iron, and rubber used in the diaphragm shall be EPDM rubber.
- E. 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. 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 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. Packing glands and/or stuffing boxes shall not be permitted.
- F. The valve manufacturer shall warrant the valve to be free of defects in material and workmanship for a period of 3 years from date of shipment, provided the valve is installed and used in accordance with all applicable instructions. Electrical components shall have a 1-year warranty.
- G. The valve manufacturer shall be able to supply a complete line of equipment from 2-inch through 24-inch sizes and a complete selection of complementary equipment. The valve manufacturer shall also provide a computerized cavitation chart which shows flow rate, differential pressure, percentage of valve opening, Cv factor, system velocity, and if there will be cavitation damage.

# 2.5 PILOT CONTROL SYSTEM

- A. The pressure reducing pilot shall be a direct-acting, adjustable, spring-loaded, normally open, diaphragm valve designed to permit flow when controlled pressure is less than the adjustable 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. Pilot control shall have a second downstream sensing port which can be utilized to install a pressure gauge. Pilot shall comply with NSF/ANSI 61 and certified lead free to NSF/ANSI372 as a safe drinking water system component.
- B. The pressure sustaining pilot shall be a direct-acting, adjustable, spring-loaded, diaphragm type relief valve. The valve is normally held closed by the force of the compression spring above the diaphragm. Control pressure is applied under the diaphragm. When the controlling pressure exceeds the spring setting, the disc is lifted off its seat, permitting flow through the control. When control pressure drops below the spring setting, the spring forces the control back to its normally closed position. The controlling pressure is applied to the chamber beneath the diaphragm through a sensing port on the valve body. Pilot shall comply with NSF/ANSI 61 and certified lead free to NSF/ANSI372 as a safe drinking water system component.
- C. The pilot control system shall include a strainer, a fixed orifice closing speed and all required control accessories, equipment, control tubing and fittings. No variable orifices shall be permitted. The pilot system shall include an opening speed control on all valves sizes 3" and smaller as standard equipment. The pilot system shall include isolation ball valves as standard equipment. The pilot system, which includes the pilot and pilot tubing, shall be constructed of 316 stainless steel. Pilots to be manufactured by control valve manufacturer.

#### 2.6 PRESSURE GAUGE

A. A liquid filled dual scale pressure gauge shall be installed on both the main valve inlet and outlet. Gauges shall be waterproof, shock resistant, and fully enclosed with stainless steel case and bronze wetted parts.

# 2.7 VALVE POSITION INDICATOR

- A. A visual position indicator assembly shall be connected to the main valve stem. The indicator rod shall be fastened directly to the valve and clearly visible on two opposite sides of the position indicator.
- B. The valve position indicator shall be Cla-Val X101 Valve Position Indicator or approved equal.

#### 2.8 FLOW METER AND DISPLAY

- A. When indicated on the plans, an insertion flow meter shall be installed in the pressure reducing and sustaining valve site.
- B. Flow meter shall be sized per PRSV size and be factory installed in the inlet tapping of the valve body.

- C. Each flow meter shall have a display unit that displays flow rate, total, pressure, position, and mA readings. The display unit shall be SCADA compatible.
- D. The flow meter shall be Cla-Val X144 e-Flow Meter or approved equal.
- E. The display unit shall be Cla-Val X145 e-Display or approved equal.

# PART 3 - EXECUTION

# 3.1 GENERAL

- A. All valves and instrumentation shall be installed in accordance with the manufacturer's recommendation. Appropriate galvanized steel pipe/flange supports shall be provided to support the valve.
- B. Where included, flow meter display shall be mounted on a concrete pedestal above ground in a lockable NEMA 4X enclosure.

END OF SECTION 400570.00

# SECTION 407910 - MISCELLANEOUS INSTRUMENT, INSTRUMENT VALVES AND FITTINGS

# PART 1 - GENERAL

# 1.01 DESCRIPTION OF WORK

- A. This section includes materials and installation of the following calibrated field mounted instruments:
  - 1. Pressure Transmitter for Reservoir Level Sensing
  - 2. Pressure Transmitters for Pump Station
  - 3. Level Transmitter for Reservoir (Ultra Sonic)
  - 4. Pressure Switches.
  - 5. Pressure Gauges
  - 6. Flow Transmitter
  - 7. Limit/Intrusion switches
  - 8. Float Switches
  - 9. Tubing, Valves, Fittings.

#### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 400105 – General Operations.

#### 1.03 SUBMITTALS

- A. Submit shop drawings in accordance with Section 013300.
- B. Shop Drawings: Indicate front and side views of enclosures with overall dimensions and weights shown, ventilation, conduit entrance locations and requirements, and nameplate legends.
- C. Product Data: Submit catalog sheets showing applicable specifications on all equipment, dimensions, and enclosure details.
- D. Test Reports: Indicate field test and inspection procedures and test results.
- E. Manufacturer's Field Reports: Indicate start-up inspection findings.

# 1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit instructions and procedures for starting and operation and operating limits. Include routine preventive maintenance schedule.

#### 1.05 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with a minimum of 3-years documented experience.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

A. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.

Handle in accordance with the manufacturer's written instructions. Lift only with lugs provided. Handle carefully to avoid damage to components, enclosure, and finish

#### 1.07 ENVIRONMENTAL REQUIREMENTS

A. All equipment shall be designed for smooth, efficient and trouble free operation in a tropical humid climate of 45 degree C ambient and a humidity of 90%.

# 1.08 APPROVALS

A. All equipment shall be listed or labeled. UL, CSA or FM

# 1.09 WARRANTY

A. Furnish a 1-year manufacturer warranty for all equipment. The manufacturer shall offer extended service warranty contracts for purchase by the Owner after the startup.

### 1.10 MAINTENANCE SERVICE

Furnish service and maintenance of video surveillance system for 1 year from the date of substantial completion.

# PART 2 - MATERIALS

# 2.1 PRESSURE TRANSMITTER FOR LEVEL SENSING

- A. Level sensing for the reservoir will be with a pressure indicating transmitter mounted on the discharge piping of the reservoir. The transmitter will communicate a pressure value to a pressure indicator located in the control room.
- B. The pressure transmitter shall be of the microprocessor-based type 2-wire system. The transmitter shall operate from a 12-24 VDC source. The output signal shall be 4 mA to 20 mA DC signal propositional to the calibrated pressure range for input into a PLC. The transmitter shall be housed in a NEMA 6P enclosure and shall be FM approved. The process media shall be potable water.
- C. Configuration data shall be stored in nonvolatile EEPROM memory in the sensor. This data shall be retained when power is interrupted, so the transmitter shall be functional immediately upon power up or if the transmitter electronics module should be changed

for upgrade or repair. The transmitter shall perform continuous self-tests. In the event of a problem, the transmitter shall activate the user-selected analog output warning.

- D. The transmitter shall be scaled for measuring 0-45 ft of water in a storage tank and display the level in feet or inches of water. Transmitter shall have a static pressure limit at least 1.5 times the pressure range. Unit shall be 24 VDC loop powered by a transmitter power supply.
- E. Process connection shall be ½-inch FNPT and constructed of 316 SS. Sensor shall be a high purity ceramic element with no oil fill and sealed with a Viton elastomer. Components shall be enclosed in a powder-coated NEMA 6P approved housing.
- F. Unit shall be rated for process temperature of minus 4 oF to 257 oF in an ambient environment of minus 40 oF to 185.oF.
- G. Reference accuracy shall be  $\pm 0.075\%$  of URV including hysteresis and non-reproducibility in accordance with IEC 60770. Total performance accuracy including hysteresis and non-reproducibility in addition to thermal change of the zero point shall be  $\pm 0.2\%$  URL.
- H. Pressure transmitter shall have an integral 4 digit LCD display with indication accuracy of  $\pm .25\%$  of calibrated span and display resolution of  $\pm .5\%$  of calibrated span.
- I. Provide the pressure transmitter with the following features:
  - 1. Over range protection.
  - 2. Vent/drain valve.
  - 3. Panel mounting bracket.
  - 4. Two electrical conduit connections, <sup>1</sup>/<sub>2</sub>-inch NPT female.
  - 5. Nameplate detailing instrument number and description of process function. Mounted on transmitter.
- J. The pressure transmitter shall be as manufactured by Endress + Hauser Cerabar S PMC71 or approved equal.

# K. Instruments:

PR	PRESSURE TRANSMITTER FOR MEASURING LEVEL					
		Santa Rita	Santa Rosa	Sinifa		
1.	Tag No.	PIT-202	PIT-301	PIT-501		
2.	Service	Reservoir Pressure	Reservoir Pressure	Reservoir Pressure		
3.	Press. Element Range	0-40 psi	0-40 psi	0-40 psi		

- L. An integral stainless steel block/bleed manifold (pre-assembled to the transmitter and leak checked) shall be provided for each transmitter. The manifold shall have a block and a vent/test valves. To be Swagelok V Series Traditional Body 2 valve manifold.
- M. The pressure transmitter shall be provided with an additional wall mounted pressure indicator display mounted in the control room. The display will have a minimum of two relay outputs configurable for process alarms. The display shall be Moore Industries model SPD or approved equal.
- N. In general, there shall be no cable or wire splices between the terminals of the equipment, unless approved by the Owner. The Contractor shall order the appropriate cable or wire lengths to eliminate cable or wire splicing. If splices are necessary in underground and in manholes for installation of cables, the Contractor shall submit, for the Owner's review and approval, the request for cable splices locations supported by cable pull calculation or other splice requirements.

# 2.2 PRESSURE TRANSMITTERS FOR PUMP STATION

- A. Pressure indicating transmitters will be built into the inlet and outlet piping of the pump station at Santa Rosa reservoir. They will communicate pressure values to the PLC operating the pump station.
- B. The pressure transmitter shall be of the microprocessor-based type 2-wire system. The transmitter shall operate from a 12-24 VDC source. The output signal shall be 4 mA to 20 mA DC signal propositional to the calibrated pressure range for input into a PLC. The transmitter shall be housed in a NEMA 6P enclosure and shall be FM approved. The process media shall be potable water.
- C. Configuration data shall be stored in nonvolatile EEPROM memory in the sensor. This data shall be retained when power is interrupted, so the transmitter shall be functional immediately upon power up or if the transmitter electronics module should be changed for upgrade or repair. The transmitter shall perform continuous self-tests. In the event of a problem, the transmitter shall activate the user-selected analog output warning.

- D. The transmitter shall be scaled for measuring 0-45 ft of water in a storage tank and display the level in feet or inches of water. Transmitter shall have a static pressure limit at least 1.5 times the pressure range. Unit shall be 24 VDC loop powered by a transmitter power supply.
- E. Process connection shall be <sup>1</sup>/<sub>2</sub>-inch FNPT and constructed of 316 SS. Sensor shall be a high purity ceramic element with no oil fill and sealed with a Viton elastomer. Components shall be enclosed in a powder-coated NEMA 6P approved housing.
- F. Unit shall be rated for process temperature of minus 4 oF to 257 oF in an ambient environment of minus 40 oF to 185.oF.
- G. Reference accuracy shall be  $\pm 0.075\%$  of URV including hysteresis and non-reproducibility in accordance with IEC 60770. Total performance accuracy including hysteresis and non-reproducibility in addition to thermal change of the zero point shall be  $\pm 0.2\%$  URL.
- H. Pressure transmitter shall have an integral 4 digit LCD display with indication accuracy of  $\pm .25\%$  of calibrated span and display resolution of  $\pm .5\%$  of calibrated span.
- I. Provide the pressure transmitter with the following features:
  - 1. Over range protection.
  - 2. Vent/drain valve.
  - 3. Panel mounting bracket.
  - 4. Two electrical conduit connections, <sup>1</sup>/<sub>2</sub>-inch NPT female.
  - 5. Nameplate detailing instrument number and description of process function. Mounted on transmitter.
- J. The pressure transmitter shall be as manufactured by Danfoss MBS 3000 Pressure Transmitter or approved equal.
- K. In general, there shall be no cable or wire splices between the terminals of the equipment, unless approved by the Owner. The Contractor shall order the appropriate cable or wire lengths to eliminate cable or wire splicing. If splices are necessary in underground and in manholes for installation of cables, the Contractor shall submit, for the Owner's review and approval, the request for cable splices locations supported by cable pull calculation or other splice requirements.
- L. Instruments:

PRESSURE TRANSMITTERS FOR PUMP STATION

		Santa Rosa Pump Station		
1.	Tag No.	PIT-302	PIT-303	
2.	Service	Inlet Pressure	Outlet Pressure	
3.	Press. Element Range	0-40 psi	0-300 psi	

M. An integral stainless steel block/bleed manifold (pre-assembled to the transmitter and leak checked) shall be provided for each transmitter. The manifold shall have a block and a vent/test valves. To be Swagelok V Series Traditional Body 2 valve manifold or approved equal.

# 2.3 ULTRASONIC LEVEL TRANSMITTER

- A. Level sensing for the reservoir will be provided by an ultrasonic level transducer built into the roof of the reservoir connected to a remoter level transmitter/monitor located in the control room. Contractor shall verify distance from the transducer for each reservoir site.
- B. In general, there shall be no cable or wire splices between the terminals of the equipment, unless approved by the Owner. The Contractor shall order the appropriate cable or wire lengths to eliminate cable or wire splicing. If splices are necessary in underground and in manholes for installation of cables, the Contractor shall submit, for the Owner's review and approval, the request for cable splices locations supported by cable pull calculation or other splice requirements.
- C. Transducer:
  - 1. Fully immerse able transducer, range 1 to 50 ft potable water.
  - 2. Beam angle 6 degrees
  - 3. Ambient temperature: minus 40 to plus 203 degrees F.
  - 4. Process connection: 1" NPT.
  - 5. Degree of protection: IP68
  - 6. Certification: UL, CSA, FM
  - 7. Cable: 2 wire twisted pair/braided and foil shielded 0.5 mm Sq. 100m/328ft.
  - 8. The Transducer will be as manufactured by Siemens, Siemens Echomax Transducer XPS-15 or approved equal.
- D. Level Transmitter/Monitor:

- 1. Level transmitter/monitor, range 1 to 50 ft potable water. Compatible with transducer in B above.
- 2. Accuracy: 0.25% of max range.
- 3. Single point monitoring, programmable, output 4-20ma for Schneider Electric SCADAPACK 334E.
- 4. Nameplate detailing instrument number and description of process function. Mounted on transmitter.
- 5. The Level Monitor will be as manufactured by Siemens, HydroRanger 200 Cat # 7ML5034 or approved equal.

#### E. Instruments:

LEVEL INDICATING TRANSMITTER					
		Santa <mark>Rita</mark>	Santa Rosa	Sinifa	
1.	Tag No.	LIT-204	LIT-304	LIT-504	
2.	Service	Reservoir Level	Reservoir Level	Reservoir Level	
3.	Static Level	1- 50 ft	1- 50 ft	1- 50 ft	

# 2.4 PRESSURE SWITCHES

- A. Pressure switches will be built into the inlet and outlet piping of the pump station at Santa Rosa reservoir. They will communicate alarms to the PLC operating the pump station.
- B. Provide pressure switches with 316 stainless steel bourdon tube actuating two independently enclosed, single pole single throw mercury switches. Switches shall have separate set point adjustments.
- C. Enclosure shall be NEMA 6P weatherproof. Mounting orientation vertical. Temperature limitation 180 degrees F. Visible calibration.
- D.  $\frac{1}{2}$ " hole for conduit hub,  $\frac{1}{2}$ " male NPT process connection.
- E. Approvals: UL, FM or CSA
- F. Switches rated for 5A inductive at 120v AC.
- G. Inaccuracy less than 1 percent at full scale.
- H. The pressure switch shall be as manufactured by Mercoid/Dwyer, 'D' Series, Square D, Ashcroft or approved equal.

- I. Pressure switches to come complete with pressure snubbers. Housing 316 stainless steel, filter disc 316 stainless steel.
- J. Instruments:

PRE	PRESSURE SWITCHES					
		Santa Rosa Pun	p Station			
1.	Tag No.	PSL-301	PSH-301	PSL-302	PSH-302	
2.	Service	Pump P-301 Inlet Pressure	Pump P-301 Outlet Pressure	Pump P-302 Inlet Pressure	Pump P-302 Outlet Pressure	
3.	Static Press. Rating	0-40 psi	0-300 psi	0-40 psi	0-300 psi	
4.	Switch opens on increasing pres.		Х		Х	
5.	Switch opens on decreasing pres.	Х		X		

# 2.5 PRESSURE GAUGES

- A. Provide pressure gauges with 316 stainless steel bourdon tube. Over range pressure (up to 130%) shall not affect calibration of the gauge.
- B. Enclosure shall be NEMA 6P weatherproof. Mounting orientation vertical. Temperature limitation 180 degrees F.
- C.  $\frac{1}{2}$ " male NPT process connection.
- D. Inaccuracy less than 1 percent at full scale.
- E. Approvals: UL, FM or CSA
- F. Unless otherwise specified, provide stem mounted or flush mounted, as required, with 4.5-inch diameter (100 mm) dial as follows.
  - 1. White faced, black numerals and black pointer.
  - 2. The scale shall have 270-degree minimum arc.
- G. The pressure gauge shall be as manufactured by Mercoid/Dwyer, Ashcroft Type 1009 or approved equal.

- H. Pressure gauges to come complete with pressure snubbers. Housing 316 stainless steel, filter disc 316 stainless steel.
- I. Instruments:

PRESSURE GAUGES										
		Santa Rosa			Santa I	nta Rosa Pump Station				
1.	Tag No.	PI-301	PI	-302	PI-303		PI-304	PI-305	PI-306	
2.	Service	Altitude Valve Inlet Press	Al Va Pro	Ititude alve OutletPump P 301 Info Press		P- let	Pump P- 301 Outlet Press	Pump P- 302 Inlet Press	Pump P- 302 Outlet Press	
3.	Pressure Range	0-40 psi	0-4	0-40 psi 0-40 j		si	0-300 psi	0-40 psi	0-300 psi	
		Santa Rita				Sini	fa			
1.	Tag No.	PI-201		PI-202	PI-50		01	PI-502	PI-502	
2.	Service	Altitude Valv Inlet Press	re	Altitude Va Outlet Pres	alve Al ss In		tude Valve t Press	Altitude V Press	alve Outlet	
3.	Pressure Range	0-40 psi		0-40 psi		0-40	psi	0-40 psi		

# 2.6 FLOW TRANSMITTER SYSTEM

- 1. Metering Tube (Detector): Consists of stainless steel tube lined with a nonconductive material connected to a remote signal amplifier (Contractor shall verify distance for each reservoir site).
- 2. Signal Amplifier and Display Unit: The amplifier receives, amplifies, and processes the detector's analog signal. Signal is converted to both analog and digital signals that are used to display rate of flow and totalization. Integrated LCD display indicates rate of flow, forward and reverse totalizers and diagnostic messages.
- 3. In general, there shall be no cable or wire splices between the terminals of the equipment, unless approved by the Owner. The Contractor shall order the appropriate cable or wire lengths to eliminate cable or wire splicing. If splices are necessary in underground and in manholes for installation of cables, the Contractor shall submit, for the Owner's review and approval, the request for

cable splices locations supported by cable pull calculation or other splice requirements.

- A. Components
  - 1. Metering Tube (Detector)
    - a. The metering tube (detector) shall be constructed of 304L stainless steel, and rated for a maximum allowable non-shock pressure and temperature for steel pipe flanges, according to ANSI B16.5.
    - b. The metering tube (detector) shall be sized per the plans.
    - c. The metering tube (detector) end connections shall be 304L stainless steel flanged, according to ANSI B16, Class 150 and AWWA Class B standards.
    - d. The insulating liner material of the metering tube (detector) shall be made of polyurethane and be NSF-61 approved for meter sizes 4" and above.
    - e. The metering tube (detector) shall include two self-cleaning measuring electrodes. The electrode material shall be corrosion resistant and constructed of 316L stainless steel.
    - f. The metering tube (detector) shall include a third "empty pipe detection" electrode located in the upper portion of the inside diameter of the flow tube in order to detect an empty pipe condition when the flow tube is running partially empty. Empty pipe detection that is not activated until the pipe is 50% empty is not acceptable.
    - g. The metering tube (detector) junction box enclosure shall be constructed of cast aluminum (powder-coated paint) and shall meet NEMA 6P (IP68) ratings.
    - h. The metering tube (detector) shall be provided with a pair of corrosion resistant grounding rings. The grounding ring material shall be 316L stainless steel.
    - i. Fluid: Potable water
    - j. Fluid Temperature Range: The fluid temperature range shall be 32°F to 178°F [0°C to 80°C] at a maximum ambient temperature of 122°F [50°C] for the hard rubber liner material.
  - 2. Signal Amplifier and Display Unit
    - a. The signal amplifier shall be microprocessor based, and shall energize the detector coils with a digitally controlled pulsed DC.

- b. The signal amplifier electrical power requirement shall be 85-265VAC, 45-65Hz. The power consumption shall not exceed 15W. The signal amplifier shall have an ambient temperature rating of -4°F to 140°F [-20°C to 60°C].
- c. The signal amplifier shall include non-volatile memory capable of storing all programmable data and accumulated totalizer values in the event of a power interruption.
- d. The signal amplifier and remote junction enclosures shall be constructed of cast aluminum (powder-coated paint) and shall meet NEMA 6P (IP68) ratings.
- e. Outputs: The signal amplifier shall provide a total of four digital outputs, one analog output and one digital input for connection to PLC.
- B. Control and Programming
  - a. The signal amplifier shall be programmed via three function buttons. The programming functions shall be available in a user-friendly, menu driven software through the four-line LCD interface.
  - b. Programmable parameters of the amplifier include, but are not limited to: calibration factors, totalizer resets, unit of measure, analog and pulse output scaling, flow-alarm functions, language selection, low-flow cutoff, noise dampening factor and excitation frequency selection.
  - c. The signal amplifier shall have a programming option allowing entry of a selected numeric password value for tamper protection.

# C. System Performance

- a. The metering system shall perform to an accuracy  $\pm 0.5$  percent of rate for velocities greater than 1.64 ft/s [0.50 m/s],  $\pm 0.0032$  ft/s [ $\pm 1$  mm/s] for velocities less than 1.64 ft/s [0.50 m/s].
- b. The metering system shall be capable of measuring the volumetric flow rate of liquids having an electrical conductivity as low as 5.0 micro mhos per centimeter.
- c. The system measuring repeatability shall be <0.10% of full scale.

# D. Indication

- a. Nameplate detailing instrument number and description of process function. Mounted on display unit.
- b. The signal amplifier shall include a four-line, 20-character, backlit LCD interface to display the following values:

- 1) Flow rate in selectable rate units
- 2) Forward totalizer in selectable volume units
- 3) Reverse totalizer in selectable volume units
- 4) Net totalizer in selectable volume units
- 5) Error or alarm messages
- 6) Software revision level
- E. The flow transmitter with remote mounted flow indicating transmitter shall be as manufactured by Endress Hauser ProMag W 400 or approved equal.
- F. Instruments:

FLOW TRANSMITTERS						
		Santa Rosa			Santa Rosa Pump Station	
1.	Tag No.	FIT-301	FIT-302		FIT-303	
2.	Service	Reservoir			Pump Stat	ion
3.	Velocity Range	0.03 to 33 ft/s				
4.	Pipe Diameter	16-inch				
		Santa Rita		Sin	ifa	
1.	Tag No.	FIT-201 FIT-201		FIT	<b>Г-501</b>	FIT-502
2.	Service	ReservoirRe			servoir	
3.	Velocity Range	0.03 to 33 ft/s 0		0.03 to 33 ft/s		
4.	Pipe Diameter	12-inch		16-inch		

# 2.7 LIMIT/INTRUSION SWITCHES

- A. Limit switch shall be provided for intrusion detection on the access hatches of the reservoir, doors of the electrical room/ pump station and on the altitude valve as shown on the P&ID.
- B. The limit switch shall be single pole single throw. The switches shall be rated for 10 amperes minimum at 120 volts ac
- C. Housing shall be heavy duty corrosion resistant NEMA 6P. Provision shall be made for ½-inch electrical conduit connection.
- D. The switch shall incorporate actuator and mounting brackets appropriately fabricated for the intended use.
- E. Approvals: UL, CSA, CE or CCC

- F. In general, there shall be no cable or wire splices between the terminals of the equipment, unless approved by the Owner. The Contractor shall order the appropriate cable or wire lengths to eliminate cable or wire splicing. If splices are necessary in underground and in manholes for installation of cables, the Contractor shall submit, for the Owner's review and approval, the request for cable splices locations supported by cable pull calculation or other splice requirements.
- G. The limit switch shall be as manufactured by Honeywell HDLS Series, Micro Switch, Allen Bradley or approved equal.

LIMIT/INTRUSION SWITCHES								
		Santa Ros	a		Santa Ros	a Pum	p St	ation
1.	Tag No.	ZSC- 304	ZSC- 304A	ZSO/C- 301	ZSC-303 ZSC-303A		C-303A	
2.	Service	Reservoir Access Hatch		Alt Valve	Pump Station			
		Santa Rita			Sinifa			
1.	Tag No.	ZSC- 204	ZSC- 204A	ZSO/C- 201	ZSC- 504	ZSC- 504A	-	ZSO/C- 501
2.	Service	Reservoir Access Hatch		Alt Valve	Reservoir Access Alt V Hatch		Alt Valve	

H. Instruments:

# 2.8 FLOAT SWITCH

- A. Float level switches shall be provided for reservoir drain vaults to detect reservoir leakage.
- B. Float shall contains a non-mercury snap action single pole switch which actuates when the longitudinal axis of the float is horizontal, and de-actuates when the liquid level falls one inch below the actuation elevation.
- C. The float shall be encapsulated to form a completely water tight and impact resistant unit. The float shall contain a snap-action switch activated by a steel ball rolling back and forth within a switching tube in a plastic float housing.
- D. Float shall be externally weighted.
- E. Approvals: UL, FM or CSA.

- F. In general, there shall be no cable or wire splices between the terminals of the equipment, unless approved by the Owner. The Contractor shall order the appropriate cable or wire lengths to eliminate cable or wire splicing. If splices are necessary in underground and in manholes for installation of cables, the Contractor shall submit, for the Owner's review and approval, the request for cable splices locations supported by cable pull calculation or other splice requirements.
- G. Floats shall be as manufactured by Endress and Hauser Floating switch type FTS20, Anchor Scientific ECO-FLOAT model type SE for suspended applications, Flygt Model EMN-10 or approved equal.
- H. Instruments:

FLOA	FLOAT SWITCHES				
		Santa Rosa	Sinifa		
1.	Tag No.	LSH-305	LSH-501		
2.	Service	Reservoir Drain Vault	Reservoir Drain Vault		

# 2.9 TUBING, VALVES AND FITTINGS

- A. Instrument tubing connections between process lines and instruments shall be ½ inch in diameter with 0.035-inch seamless wall, annealed ASTM A 269, Type 316 stainless steel.
- B. Fittings shall be Type 316 stainless-steel double ferrule design. Fittings shall be Swagelok, Parker CPI, or approved equal.
- C. Valves shall be full port ball valves with Type 316 stainless-steel body and Teflon seats and packing. Valves shall be Parker CPI, Whitey, or approved equal.

# PART 3 - EXECUTION (NOT USED)

END OF SECTION 407910

# SANTA ROSA

C510, C513, C605, C606, C610, M001, M100, M101, M102, E102, E503, E601, C701

# SANTA RITA

C512, S001, M001, M100, M101, M102, E302, E303

# **SINIFA**

C100, C101, C201, C211, C300, C512, M001, M100, M101, M102, E102, E303, E304





GENERAL NOTES:

١.	DESIGN LOADS	
	1. ROOF LOAD	: 20.0 PSF LIVE
	3. BACKFILL HEIGHT (BELOW TOP OF FOOTING)	: VARIES (0'-6" TO 0'-9")
11.	<u>GEOTECHNICAL DESIGN CRITERIA</u>	· 121 PCE (MOIST LINIT WEICHT)
	T. SUBGRADE SUE FARAMETERS	· 35° (ANGLE OF INTERNAL FRICTION)
		: 400 KCF (MODULUS OF SUBGRADE REACTION)
	2. PASSIVE PRESSURE	: 1000 PSF (UNIFORM WITH DEPTH)
	3. DIFFERENTIAL SETTLEMENT	: 0.165" OVER 33'-0" RADIUS
	4. CAST-IN-DRILLED HOLE CONCRETE PILES	
	4.1. PILE DIAMETER	: 18"
	4.2. PILE DEPTH	$: 40^{\circ} - 0^{\circ}$
	4.3. ALLOWABLE COMPRESSION	: ZUU KIPS (DEAD+LIVE LUADS) (NOMINAL)
		: 545 KIPS MAX (DEAD+LIVE LUADS) (SERVICE) : 620 KIPS (TOTAL DESIGN LOADS INCLUDING WIND
		(FACTORED)
	4.4. LATERAL LOAD	: 60 KIPS (WITH 2'-0" THICK OF FLOWABLE FILL BE
.	WIND DESIGN DATA	
	1. DESIGN WIND SPEED 2. PISK CATECORY	: 210 MPH (ASCE /-10)
	3. WIND EXPOSURE CATEGORY	: C
IV.	LARIHQUAKE DESIGN DATA 1 RISK CATECORY	• 1\/
	2. SEISMIC IMPORTANCE FACTOR. le	: 1.5 (ASCE 7-10/AWWA D110-13)
	,	1.25 (ACI 350.3-06)
	3. Ss	: 2.79g (UFC)
	4. S1	: 0.68g (UFC)
	5. SITE CLASS	: D
	6. SUS 7 SD1	: 1.86g • 0.68a
	8. SEISMIC DESIGN CATEGORY	: D
	9. SEISMIC FORCE-RESISTING SYSTEM	: ANCHORED FLEXIBLE BASE
	10. DESIGN BASE SHEAR	: 4,662 KIPS D = 3.25 (ASCE 7, 10 (ACL 350.3, 06)
	II. RESPONSE MODIFICATION COEFFICIENTS	R = 3.25 (ASCE 7 - 10/ACT 550.5 - 06) $R = 3.5 R_{c} = 1.0 (AWWA D110 - 13)$
	12. ANALYSIS PROCEDURE USED	: EQUIVALENT LATERAL FORCE PROCEDURE
	13. EFFECTIVE SEISMIC ACCELERATIONS	: 0.6132g (H), 0.3796g (V) [ALLOWABLE]
	14. SEISMIC SPECTRAL VELOCITY	: 5.223 FT/SEC (ASCE 7-10)
\ /	CONCRETE REQUIREMENTS	
۷.	$\frac{\text{CONCRETE REQUIREMENTS}}{1  \text{PIPE ENCASEMENTS}} \Delta$	· 4 000 PSLAT 28 DAYS (MIN)
	2. ROOF	: 4,000 PSI AT 28 DAYS (MIN)
	3. COREWALL	: 4,000 PSI AT 28 DAYS (MIN)
	4. SHOTCRETE	: 4,500 PSI (1C:3S) AT 28 DAYS (MIN)
	5. MAT SLAB	: 4,000 PSI AT 28 DAYS (MIN)
	6. CIDH PILES	: 4,000 PSI AT 28 DAYS (MIN)
	7. SEE TECHNICAL SPECIFICATION FOR COMPLET SHRINKAGE REQUIREMENTS AND ACCEPTABLE	E MIX DESIGN INFORMATION INCLUDING AGGREGATE SIZE F ADMIXTURES
	8. SEE TECHNICAL SPECIFICATION FOR CONCRET	E PLACING AND FORMING PROCEDURES.
	9. ALL CONCRETE SHALL BE TYPE II/V CEMENT	•
\/I	REINFORCEMENT REQUIREMENTS	$\Delta$
۷۱.	1. ALL REINFORCING IN TANK AND PILES SHALL	$\mathcal{K}$ conform to astm A-615 grade 60 unless other
(	DRAWINGS.	
	2. ALL REINFORCING STEEL IN TANK AND PILES	SHALL BE GALVANIZED WITH CLASS 1 COATING IN ACC
	3. REINFORCING STEEL SHALL NOT BE WELDED	UNLESS APPROVED BY THE CONTRACTING OFFICER.
VII.	EARTHWORK REQUIREMENTS	

VIII. APPURTENANCE NOTES WHERE EXTERIOR APPURTENANCES REQUIRE ANCHORS TO BE PLACED ON THE WALL EXTERIOR, DRILL AND 1. PLACE AFTER WRAPPING AND BEFORE FINAL SHOTCRETING. TAKE EXTREME CARE TO AVOID DAMAGING THE PRESTRESSING STRAND. PLACE A STEEL PIPE AROUND THE DRILL BIT TO KEEP THE BIT FROM COMING IN CONTACT WITH THE PRESTRESSING STRAND. INSTALL INSERTS BEFORE SHOTCRETING TO MARK HOLE LOCATION. FOR ALL TYPES OF ANCHORING SYSTEMS, INCLUDING DROP-IN AND EXPANSION WEDGE ANCHORS, FILL HOLE IN SHOTCRETE AND WALL WITH EPOXY BEFORE FINAL INSTALLATION OF ANCHORS TO INSURE COMPLETE COVERAGE AND PROTECTION OF THE STRAND. 2. ADHESIVE ANCHORS WITH 1 INCH MAXIMUM EMBEDMENT INTO THE SHOTCRETE MAY ONLY BE USED IN NON-STRUCTURAL APPLICATIONS AND WHEN APPROVED BY THE DESIGN ENGINEER. WHEN DRILLING HOLES IN THE SHOTCRETE, THE DRILL MUST BE EQUIPPED WITH A POSITIVE STOP TO PREVENT DRILLING MORE THAN 1 INCH IN DEPTH. USE EPOXY TO INSURE COMPLETE COVERAGE AND PROTECTION OF THE PRESTRESSING STRAND. DO NOT USE EXPANSION OR DROP-IN ANCHORS. USE SST 316 BOLTS AND ANCHORS UNLESS NOTED OTHERWISE, WHERE SST BOLTS OR ANCHORS ARE IN 3. CONTACT WITH DISSIMILAR METALS, USE INSULATING SLEEVES AND PHENOLIC WASHERS TO ELECTRICALLY ISOLATE THE BOLTS. IX. BUCKLING CRITERIA OF WALL DESIGN 1. INTEGRITY OF THE WALL SHOWN ON THESE DRAWINGS IS STRICTLY PREDICATED ON THE FOLLOWING CONDITIONS: 1.1. THE STRICT CONFORMANCE TO THE CLOSE STRESS-TOLERANCE AND OTHER REQUIREMENTS OF THE OR SEISMIC FORCES) CIRCUMFERENTIAL PRESTRESSING APPLICATION INDICATED IN THE TECHNICAL SPECIFICATIONS AND THE CIRCUMFERENTIAL PRESTRESSING NOTES ON SHEET S122. ELOW THE PILE CAP) 1.2. SEE SPECIFICATIONS FOR OUT OF ROUND TOLERANCE 1.3. THERE SHALL BE NO BLOCK-OUTS OR OTHER TYPES OF WALL OPENINGS OTHER THAN THOSE SHOWN ON THESE DRAWINGS. X. SPECIAL INSPECTION 1. SPECIAL INSPECTIONS REQUIRED FOR THIS PROJECT AND SHALL BE PERFORMED IN ACCORDANCE WITH IBC CHAPTER 17. SPECIAL INSPECTIONS SHALL BE PERFORMED BY A REGISTERED DEPUTY INSPECTOR EMPLOYED BY THE OWNER IN THESE CATEGORIES: PILE DRILLING PILE PLACEMENT LOCATIONS, PLUMBNESS, DIAMETER, AND LENGTH REINFORCING STEEL PLACEMENT CONCRETE PLACEMENT PRESTRESSING STRUCTURAL WELDING CONCRETE ANCHORS GRADING, EXCAVATING, AND BACKFILLING XI. <u>STRUCTURAL OBSERVATION</u> THE ENGINEER OF RECORD, OR A REGISTERED ENGINEER EMPLOYED BY THE OWNER, SHALL PERFORM STRUCTURAL OBSERVATION AS REQUIRED BY IBC CHAPTER 17. STRUCTURAL OBSERVATION SHALL BE PROVIDED DURING THE STAGES OF CONSTRUCTION LISTED BELOW. IT SHALL BE THE SOLE RESPONSIBILITY OF THE CONTRACTOR TO PROVIDE AT LEAST 3 WORKING DAYS ADVANCE NOTICE TO THE OWNER WHEN HIS WORK IS READY FOR STRUCTURAL OBSERVATION FOR EACH OF THESE STAGES: CIDH PILES, MAT SLAB, FIRST WALL, COLUMN, ROOF  $\bigcirc$ GUAM WATERWORKS AUTHORI Good Water Always ENGINEER TG ENGINEERS,PC, GUAM MICHAEL BAKER INTERNATION E, CEMENT CONTENT, STANDARD AWWA D110-13, TYPE I NOMINAL YEAR 1 MG CAPACITY COMPLETED INSIDE WALL 66'-0" WISE NOTED ON THESE DIAMETER HEIGHT OVERFLOW SPECIFIC CORDANCE WITH ASTM 40'-0" HEIGHT GRAVITY CORE WALL SHOTCRETE 11" THICKNESS THICKNESS GENERAL 1. MINIMUM COMPACTION OF CRUSHED ROCK AND SUBGRADE UNDER AND AROUND PIPE BLOCKS SHALL EQUAL 95% OF MAX CONTRACTOR DENSITY AS DETERMINED IN ACCORDANCE WITH ASTM D1557. 2. SEE CIVIL DRAWINGS, TECHNICAL SPECIFICATIONS, AND GEOTECHNICAL REPORT FOR COMPLETE REQUIREMENTS. TANK CONTRACTOR  $\bigcirc$ 5" NAME PLATE DETAIL NOTES NAME PLATE TO BE SS 316. ATTACH TO LADDER SLEEVE WITH 4 FLAT HEAD SS SCREWS. 3. EXACT LOCATION OF PLATE ATTACHMENT TO BE DETERMINED BY GWA.

$\circ$
"
$\bigcirc$


KOUP	PIPE (SEE NOTE 13)	FITTINGS	VALVE. 6 INCHES AND SMALLER (SEE NOTE 1. NOTE 11 & NOTE 16)				
<u>NO.</u> 1	STEEL, ASTM A53, SCHEDULE 40, BLACK WELDED	2-INCH AND SMALLER MALLEABLE IRON, ANSI B16.3, THREADED, BANDED, BLACK, 150 PSI OR STEEL, ANSI B16.9, BUTT-WELDED. 3 INCH AND LARGER, CAST IRON, ANSI B16.1, 125 PSI FLANGED OR MECHANICAL COUPLINGS	BRONZE, THREADED, GATE, CRANE NO. 428 UB OR STOCKHAM B-105. GLOBE, STOCKHAM B-37, CHECK, CRANE NO.37 OR STOCKHAM B-139, STEEL, LUBRICATED PLUG, NORDSTORM FIG. 142 OR 143 OR SERCK-AUDCO LSW 144 GG. ECCENTRIC PLUG, DEZURIK SERIES 118 OR KEYSTONE 541. BALL, JAMESBURY FIG 351 OR WATTS NO. B 6080				
2	SAME AS GROUP NO. 1	CAST IRON, ANSI B16.12, THREADED, DRAINAGE PATTERN					
3	SAME AS GROUP NO. I	BANDED, GALVANIZED, 300 PSI	CRANE 366 E OR MILWAUKEE NO. 544. BALL, JAMESBURY FIG 351 OR WATTS NO. B6080				
4	STEEL, ASTM A53, SCHEDULE 40 WELDED, GALVANIZED	2-INCH AND SMALLER MALLEABLE IRON, ANSI B16.3, THREADED, BANDED, GALVANIZED, 150 PSI. 3 INCH AND LARGER, CAST IRON, ANSI B16.1, 125 PSI FLANGED OR MECHANICAL COUPLINGS	2-INCH AND SMALLER, ECCENTRIC PLUG, SYNTHETIC RUBBER FACED, DEZURIK 118S OR KEYSTONE 541. BALL JAMESBURY FIG. 351 OR WATTS NO. B 6080. 3 INCH AND LARGER, ECCENTRIC PLUG, SYNTHETIC RUBBER FACED, DEZURIK 118F OR KEYSTONE 580. GATE, AWWA C500. BUTTERFLY, AWWA, FLANGED				
5	SAME AS GROUP NO. 4	MALLEABLE IRON, ANSI B16.3, THREADED, BANDED, GALVANIZED, 300 PSI	BRONZE THREADED, GLOBE, CRANE NO. 212P OR STOCKHAM B-62 OR B-32T. BALL, JAMESBURY FIG 351 OR WATTS NO. B-6080. CHECK, CRANE NO. 27 OR STOCKHAM B-322T				
6	STEEL, ASTM A106 OR A53, SCHEDULE 80, SEAMLESS, BLACK	FORGED STEEL, ANSI B16.11, SOCKET WELDED OR THREADED, BLACK, 2000 PSI, OR STEEL, ANSI B16.9, BUTT-WELDED, SCHEDULE 80	CAST IRON, LUBRICATED PLUG, NORDSTORM FIG. 214 OR 305 OR SERCK-AUDCO MSW 544 GG				
7	SAME AS GROUP NO. 6	1-INCH AND SMALLER, FORGED STEEL, ANSI B16.11, THREADED OR SOCKET WELDED, BLACK, 3000 PSI WITH FLANGED AMMONIA UNIONS. 1-INCH AND LARGER, STEEL, ANSI B16.9, BUTT-WELDED OR FLANGED, SCHEDULE 80	SEMI-PLUG AND YOKE TYPE OR BALL FOR CHLORINE SERVICE, FORGED CARBON STEEL				
8	WELDED STEEL, AWWA C200, UNLINED	WELDED STEEL, FABRICATED, AWWA C200, UNLINED	AS INDICATED ON DRAWINGS				
9	STEEL, ASTM A106, OR A53, SCHEDULE 40, SEAMLESS, BLACK	STEEL, ANSI B16.9, BUTT-WELDED. CAST IRON, ANSI B16.1, 125 PSI, FLANGED. FORGED STEEL, SOCKET WELDED, ANSI B16.11, 2000 PSI OR STEEL, ANSI B16.5, 150 PSI FLANGED	CAST IRON, FLANGED, LUBRICATED PLUG, NORDSTORM FIG 143 OR SERCK-AUDCO MSW 133 GG				
10	WELDED STEEL, AWWA C200, CEMENT MORTAR LINED & COATED, AWWA C205	WELDED STEEL, AWWA C200, FABRICATED, CEMENT MORTAR LINED & COATED, AWWA C205	AS INDICATED ON DRAWINGS				
11	WELDED STEEL, AWWA C200, CEMENT MORTAR LINED, AWWA C205, FUSION-BONDED EPOXY COATED, AWWA C213	WELDED STEEL, AWWA C200, FABRICATED, CEMENT MORTAR LINED, AWWA C205, FUSION-BONDED EPOXY COATED AWWA C213	AS INDICATED ON DRAWINGS				
<u>12</u>	STAINLESS STEEL, TYPE 316, ASTM A312, SCHEDULE 40S	STAINLESS STEEL, TYPE 316 ANSI B16.3, SCREWED, 150 PSI ANSI B16.9, BUTT-WELDED, SCHEDULE 40S, OR 150 PSI FLANGED	STAINLESS STEEL, BALL, FLANGED, WATTS SERIES 2500 OR JAMESBURY TYPE A/D150F. CHECK, LADISH, NO. 5272 OR CRANE FIG. 377 OR AS SHOWN ON DRAWINGS				
13	STEEL ASTM A106 OR A53, SCHEDULE 40, SEAMLESS, BLACK, PVDF OR PTFE LINED.	STEEL, ANSI B16.5, 150 PSI FLANGED, PFDF OR PTFE LINED	CAST STEEL PLUG, DIAPHRAGM OR CHECK 150PSI FLANGED, PVDF OR PTFE LINED				
14	DUCTILE IRON, ANSI A21.51, (AWWA C151) OR CAST IRON ANSI A21.6, 150 PSI, BELL AND SPIGOT, MECHANICAL JOINTS, MECHANICAL COUPLINGS, OR 125 PSI FLANGED (TYPICAL SERVICE – WATER LINES)	DUCTILE IRON OR CAST IRON, ANSI A21.10, OR AWWA C110, BELL AND SPIGOT, MECHANICAL COUPLINGS, FLANGED OR MECHANICAL JOINTS, 250 PSI, (PRESSURE RATING) 12 INCHES AND SMALLER, 150 PSI, (PRESSURE RATING) 14 INCHES AND LARGER, WITH 125 PSI ANSI B16.1 FLANGES.	GATE, AWWA C500, 'O' RING SEALS, MECHANICAL JOINT ENDS, MUELLER A-2380-20, OR CLOW F-5065. BUTTERFLY, AWWA. ECCENTRIC PLUG, DEZURIK SERIES 118 OR KEYSTONE 541, BALL, PRATT OR APCO-WILLAMETTE				
15	COPPER, ASTM B88, TYPE K, SOFT TEMPERED WHERE BURIED, HARD TEMPERED WHERE EXPOSED	WROUGHT COPPER OR CAST BRONZE, ANSI B16.22, SOLDER JOINT, 150 PSI, OR COMPRESSION FITTINGS. (FOR OXYGEN PIPING USE SILVER SOLDER, FOR COMPRESSED AIR AIR PIPING USE 95-5 TIN-ANTIMONY SOLDER)	BRONZE, SOLDER JOINT, GLOBE, CRANE NO. 1310 OR STOCKHAM B-14T. CHECK, CRANE NO. 1342 OR 36, OR STOCKHAM B-309 OR B-345, GATE, CRANE NO. 426, OR STOCKHAM B-104 OR B-105				
16	REINFORCED CONCRETE, ASTM C76, TONGUE AND GROOVED JOINTS. (TYPICAL SERVICE-CULVERTS)	SAME AS GROUP NO. 10					
17	REINFORCED CONCRETE, AWWA C302, CLASS-SEE DRAWINGS. (TYPICAL SERVICE - PRESSURE PIPELINES)	SAME AS GROUP NO. 10	AS INDICATED ON DRAWINGS				
18	POLYVINYL CHLORIDE, SCHEDULE 80, NORMAL IMPACT. ASTM D1785-PERFORATED WALL	POLYVINYL CHLORIDE, SCHEDULE 80, NORMAL IMPACT, SOCKET SOLVENT WELD JOINTS, ASTM D2467	POLYVINYL CHLORIDE, BALL, DIAPHRAGM, BUTTERFLY, BALL OR LIFT CHECK, NIBCO/CHEMTROL, HILLS-MCCANNA OR R&G SLOAN MFG. CO				
19	POLYVINYL CHLORIDE PRESSURE PIPE ASTM D2241 WITH BELL AND SPIGOT JOINTS	CAST IRON, 150 PSI, FOR POLYVINYL CHLORIDE PIPE, AWWA C110 CEMENT MORTAR LINED, AWWA C104	SAME AS GROUP NO. 13				
20	POLYVINYL CHLORIDE, SDR35, ASTM 3034	SAME AS GROUP NO. 19	SAME AS GROUP NO. 13				
21	HIGH DENSITY POLYETHYLENE PIPE, PROFILE WALL, ASTM F2648, BELL AND SPIGOT	HIGH DENSITY POLYETHYLENE PIPE, ASTM F2306, BELL AND SPIGOT					
22	FIBERGLASS REINFORCED PLASTIC, ASTM D2996 FILAMENT-WOUND, SOCKET AND SPIGOT ENDS, ADHESIVE BONDED	FIBERGLASS REINFORCED PLASTIC, FILAMENT-WOUND, SOCKET ENDS, ADHESIVE BONDED, OR FIBERGLASS FLANGED	PLASTIC LINED, FLANGED. FLANGES TO MATCH 150 PSI ANSI B16.5 DIMENSIONS, OR AS INDICATED ON DRAWINGS				
23	POLYVINYL CHLORIDE, SCHEDULE 80, NORMAL IMPACT. ASTM D1785	POLYVINYL CHLORIDE, SCHEDULE 80, NORMAL IMPACT, SOCKET SOLVENT WELD JOINTS, ASTM D2467, OR 150 PSI FLANGED	POLYVINYL CHLORIDE, BALL, DIAPHRAGM, BUTTERFLY, BALL OR LIFT CHECK, NIBCO/CHEMTROL, HILLS-MCCANNA OR R&G SLOAN MFG. CO				
24	HIGH DENSITY POLYETHYLENE PIPE, PROFILE WALL, ASTM F2648, BELL AND SPIGOT— PERFORATED WALL	HIGH DENSITY POLYETHYLENE PIPE, ASTM F2306, BELL AND SPIGOT					

FLUID	FUNCTION						
ABBREVIATION	THIS LIST INCLUDES SOME LINES NOT USED IN THIS PROJECT						
OF	OVERFLOW						
PW	POTABLE WATER						
RD	RESERVOIR DRAIN						
SDR	STORM DRAIN						
UD	UNDERDRAIN						

YPICAL PIPE DESIGNATION: — PIPE M 2" PW (11) IPE DIAMETER ——/ └──FLUID ABBRE <u>NOTES</u> ENERAL NOTE THOUGH SEVERAL PIPING MATERIALS ARE USED FOR A GIVEN FUNCTION, ONLY THI PING MATERIAL SHOWN ON THE CONSTRU ND SPECIFICATIONS SHALL BE USED. THE DT HAVE THE OPTION TO USE A DIFFEREN OTE 1 ROPRIETARY NAMES HAVE BEEN QUOTED ENTIFICATION PURPOSES ONLY. SUBSTITUT ERMITTED SUBJECT TO PROVISIONS OF THE <u>) TE 2</u> EAKAGE ALLOWANCE IS AS FOLLOWS: PIPES SO DESIGNATED SHALL SHOW ZEF PIPES SO DESIGNATED SHALL SHOW ZER UNBURIED PIPE AND NOT MORE THAN HOUR PER INCH DIAMETER PER 100 FE PIPES SO DESIGNATED SHALL NOT SHOW MORE THAN 0.15 GALLON PER HOUR PE DIAMETER PER 100 FEET OF PIPE. PIPE SO DESIGNATED SHALL NOT SHOW PRESSURE OF MORE THAN 5 PERCENT. PIPES SO DESIGNATED SHALL NOT SHOW VACUUM OF MORE THAN 4 INCHES MER <u>) TE 3</u> OR FIELD TEST PROCEDURES AND ADDITIO EQUIREMENTS, SEE PIPING SECTION OF SPE <u>OTE 4</u> NY DEVIATION FROM THE PIPING MATERIAL EQUIREMENTS SHOWN WILL BE NOTED IN ON THE DRAWINGS. <u>OTE 5</u> PING GROUP NUMBER SHOWN THUS \* SHA E PIPING SECTION OF SPECIFICATIONS FOR ATERIALS. <u>) TE 6</u> TATIC WATER TEST WITH SURFACE 5 FEET PIPE. <u>OTE 7</u> SPECTION AND TESTING SHALL BE IN ACC PPLICABLE NATIONAL FIRE PROTECTION AS TANDARDS. <u>OTE 8</u> APPARENT LEAKS UNDER NORMAL OPER OTE 9 ISPECTION AND TESTING SHALL BE IN ACC PPLICABLE NATIONAL FIRE PROTECTION AS TANDARDS. <u> DTE 10</u> PING MATERIALS SHALL BE IN ACCORDANC RE PROTECTION ASSOCIATION STANDARDS. OR VALVES 8 INCHES AND LARGER SEE V/ OR SPECIAL VALVES SEE SPECIFICATIONS. <u>OTE 12</u> HANGE IN PIPING MATERIALS GROUP NUMB IUS: ——� <u>DTE 13</u> OR PIPE LINING AND COATING, SEE SPECIF OTE 14 XPOSED PIPING SHALL BE PAINTED IN ACC PECIFICATIONS. COLORS TO BE SELECTED <u>OTE 15</u> PING MATERIAL SHALL BE NON-ABRASIVE OSE AND QUICK CONNECTION COUPLINGS EQUIPMENT. <u>OTE 16</u> ALVES 2.5 INCH AND SMALLER MAY HAVE

VALVE 3 INCH AND LARGER SHALL HAVE F UNLESS OTHERWISE SHOWN OR SPECIFIED.

	9 TE	APPR
	3/8/	4/ 23/
IATERIAL		
		N
ΕνιατιώΝ		
	REVIS	CRIPTION
	$\triangleleft$	SYM DES
E SHOWN THAT MAY HE CALLED OUT ICTION DRAWINGS CONTRACTOR DOES NT MATERIAL.		ΙΟΒΙΤΥ
FOR TIONS WILL BE IE SPECIFICATIONS.		KS AUTH Always
RO LEAKAGE. RO LEAKAGE FOR 0.02 GALLON PER ET OF BURIED PIPE. W A LEAKAGE OF ER INCH OF		A WATERWOR Good Wate
A LOSS OF		NAN
W A LOSS OF RCURY COLUMN.		0
PNAL TEST PECIFICATION.	ini: or u	s work was prepared by me nder my responsible control
LS OR FIELD TEST THE SPECIFICATIONS		No 1851 CIVIL EXP. <u>04/30/19</u>
ALL BE INSULATED, DR INSULATING		BARESS JONAL ENGINEER
ABOVE HIGH POINT		ENGINEERS, PC
CORDANCE WITH SSOCIATION		
RATING CONDITIONS.		BAR IS ONE INCH ON
CORDANCE WITH SSOCIATION	( IF NO ADJU	ORIGINAL DRAWING )  TONE INCH ON THIS SHEET, JST SCALES ACCORDINGLY
ICE WITH NATIONAL	DATE	E:         OCT 12, 2018           .E:         AS SHOWN
ALVE SCHEDULE.	DESI	GN: XXTE/JA CK: XXJN WN: XXIA
BER IS INDICATED	JOB 7 FILE:	#: W14-007-BND
FICATIONS.		N N
CORDANCE WITH	Ц Ц	LOTE
E FLEXIBLE RUBBER	RVO	
WITH GROUP NO. 1	SESE 25	EME ES A
E SCREWED ENDS FLANGED ENDS,	RITAF	EPLACE
	NTA	SCI
	SA	DING
	SHEE	T NO. ΜΟΟ1
		87 OF 110

























DUP	PIPE (SEE NOTE 13)	FITTINGS	VALVE, 6 INCHES AND SMALLER (SEE NOTE 1, NOTE 11 & NOTE 16)
10.	STEEL, ASTM A53, SCHEDULE 40, BLACK WELDED	2-INCH AND SMALLER MALLEABLE IRON, ANSI B16.3, THREADED, BANDED, BLACK, 150 PSI OR STEEL, ANSI B16.9, BUTT-WELDED. 3 INCH AND LARGER, CAST IRON, ANSI B16.1, 125 PSI FLANGED OR MECHANICAL COUPLINGS	BRONZE, THREADED, GATE, CRANE NO. 428 UB OR STOCKHAM B-105. GLOBE, STOCKHAM B-37, CHECK, CRANE NO.37 OR STOCKHAM B-139, STEEL, LUBRICATED PLUG, NORDSTORM FIG. 142 OR 143 OR SERCK-AUDCO LSW 144 GG. ECCENTRIC PLUG, DEZURIK SERIES 118 OR KEYSTONE 541. BALL, JAMESBURY FIG 351 OR WATTS NO. B 6080
2	SAME AS GROUP NO. 1	CAST IRON, ANSI B16.12, THREADED, DRAINAGE PATTERN	
3	SAME AS GROUP NO. 1	MALLEABLE IRON, ANSI B16.3, THREADED, BANDED, GALVANIZED, 300 PSI	ECCENTRIC PLUG, DEZURIK SERIES 118 OR KEYSTONE 541. CHECK CRANE 366 E OR MILWAUKEE NO. 544. BALL, JAMESBURY FIG 351 OR WATTS NO. B6080
4	STEEL, ASTM A53, SCHEDULE 40 WELDED, GALVANIZED SAME AS GROUP NO. 4	2-INCH AND SMALLER MALLEABLE IRON, ANSI B16.3, THREADED, BANDED, GALVANIZED, 150 PSI. 3 INCH AND LARGER, CAST IRON, ANSI B16.1, 125 PSI FLANGED OR MECHANICAL COUPLINGS MALLEABLE IRON, ANSI B16.3, THREADED, BANDED, GALVANIZED, 300 PSI	2-INCH AND SMALLER, ECCENTRIC PLUG, SYNTHETIC RUBBER FACED, DEZURIK 118S OR KEYSTONE 541. BALL JAMESBURY FIG. 351 OR WATTS NO. B 6080. 3 INCH AND LARGER, ECCENTRIC PLUG, SYNTHETIC RUBBER FACED, DEZURIK 118F OR KEYSTONE 580. GATE, AWWA C500. BUTTERFLY, AWWA, FLANGED BRONZE THREADED, GLOBE, CRANE NO. 212P OR STOCKHAM B-62 OR B-32T. BALL, JAMESBURY FIG 351 OR WATTS NO. B-6080.
6	STEEL, ASTM A106 OR A53, SCHEDULE 80,	FORGED STEEL, ANSI B16.11, SOCKET WELDED OR THREADED, BLACK,	CHECK, CRANE NO. 27 OR STOCKHAM B-322T CAST IRON, LUBRICATED PLUG, NORDSTORM FIG. 214 OR 305 OR SERCK-AUDCO MSW 544 GG
7	SAME AS GROUP NO. 6	1-INCH AND SMALLER, FORGED STEEL, ANSI B16.11, THREADED OR SOCKET WELDED, BLACK, 3000 PSI WITH FLANGED AMMONIA UNIONS. 1-INCH AND LARGER, STEEL, ANSI B16.9, BUTT-WELDED OR FLANGED, SCHEDULE 80	SEMI-PLUG AND YOKE TYPE OR BALL FOR CHLORINE SERVICE, FORGED CARBON STEEL
8	WELDED STEEL, AWWA C200, UNLINED	WELDED STEEL, FABRICATED, AWWA C200, UNLINED	AS INDICATED ON DRAWINGS
9	STEEL, ASTM A106, OR A53, SCHEDULE 40, SEAMLESS, BLACK	STEEL, ANSI B16.9, BUTT-WELDED. CAST IRON, ANSI B16.1, 125 PSI, FLANGED. FORGED STEEL, SOCKET WELDED, ANSI B16.11, 2000 PSI OR STEEL, ANSI B16.5, 150 PSI FLANGED	CAST IRON, FLANGED, LUBRICATED PLUG, NORDSTORM FIG 143 OR SERCK-AUDCO MSW 133 GG
10	WELDED STEEL, AWWA C200, CEMENT MORTAR LINED & COATED, AWWA C205	WELDED STEEL, AWWA C200, FABRICATED, CEMENT MORTAR LINED & COATED, AWWA C205	AS INDICATED ON DRAWINGS
	WELDED STEEL, AWWA C200, CEMENT MORTAR LINED, AWWA C205, FUSION-BONDED EPOXY COATED, AWWA C213	WĚLDEĎ STĚEL, AWWA CŽOO, FABŘICATED, ČEMĚNT MORTAR LINED, AWWA C205, FUSION-BONDED EPOXY COATED AWWA C213	AS INDICATED ON DRAWINGS
12	STAINLESS STEEL, TYPE 316, ASTM A312, SCHEDULE 40S	STAINLESS STEEL, TYPE 316 ANSI B16.3, SCREWED, 150 PSI ANSI B16.9, BUTT-WELDED, SCHEDULE 40S, OR 150 PSI FLANGED	STAINLESS STEEL, BALL, FLANGED, WATTS SERIES 2500 OR JAMESBURY TYPE A/D150F. CHECK, LADISH, NO. 5272 OR CRANE FIG. 377 OR AS SHOWN ON DRAWINGS
13	STEEL ASTM A106 OR A53, SCHEDULE 40, SEAMLESS, BLACK, PVDF OR PTFE LINED.	STEEL, ANSI B16.5, 150 PSI FLANGED, PFDF OR PTFE LINED	CAST STEEL PLUG, DIAPHRAGM OR CHECK 150PSI FLANGED, PVDF OR PTFE LINED
14	DUCTILE IRON, ANSI A21.51, (AWWA C151) OR CAST IRON ANSI A21.6, 150 PSI, BELL AND SPIGOT, MECHANICAL JOINTS, MECHANICAL COUPLINGS, OR 125 PSI FLANGED (TYPICAL SERVICE – WATER LINES)	DUCTILE IRON OR CAST IRON, ANSI A21.10, OR AWWA C110, BELL AND SPIGOT, MECHANICAL COUPLINGS, FLANGED OR MECHANICAL JOINTS, 250 PSI, (PRESSURE RATING) 12 INCHES AND SMALLER, 150 PSI, (PRESSURE RATING) 14 INCHES AND LARGER, WITH 125 PSI ANSI B16.1 FLANGES.	GATE, AWWA C500, 'O' RING SEALS, MECHANICAL JOINT ENDS, MUELLER A-2380-20, OR CLOW F-5065. BUTTERFLY, AWWA. ECCENTRIC PLUG, DEZURIK SERIES 118 OR KEYSTONE 541, BALL, PRATT OR APCO-WILLAMETTE
15	COPPER, ASTM B88, TYPE K, SOFT TEMPERED WHERE BURIED, HARD TEMPERED WHERE EXPOSED	WROUGHT COPPER OR CAST BRONZE, ANSI B16.22, SOLDER JOINT, 150 PSI, OR COMPRESSION FITTINGS. (FOR OXYGEN PIPING USE SILVER SOLDER, FOR COMPRESSED AIR AIR PIPING USE 95-5 TIN-ANTIMONY SOLDER)	BRONZE, SOLDER JOINT, GLOBE, CRANE NO. 1310 OR STOCKHAM B-14T. CHECK, CRANE NO. 1342 OR 36, OR STOCKHAM B-309 OR B-345, GATE, CRANE NO. 426, OR STOCKHAM B-104 OR B-105
16	REINFORCED CONCRETE, ASTM C76, TONGUE AND GROOVED JOINTS. (TYPICAL SERVICE-CULVERTS)	SAME AS GROUP NO. 10	
17	REINFORCED CONCRETE, AWWA C302, CLASS-SEE DRAWINGS. (TYPICAL SERVICE - PRESSURE DIDELINES)	SAME AS GROUP NO. 10	AS INDICATED ON DRAWINGS
18	POLYVINYL CHLORIDE, SCHEDULE 80, NORMAL IMPACT. ASTM D1785-PERFORATED WALL	POLYVINYL CHLORIDE, SCHEDULE 80, NORMAL IMPACT, SOCKET SOLVENT WELD JOINTS, ASTM D2467	POLYVINYL CHLORIDE, BALL, DIAPHRAGM, BUTTERFLY, BALL OR LIFT CHECK, NIBCO/CHEMTROL, HILLS-MCCANNA OR R&G SLOAN MFG. CO
19	POLYVINYL CHLORIDE PRESSURE PIPE ASTM D2241 WITH BELL AND SPIGOT JOINTS	CAST IRON, 150 PSI, FOR POLYVINYL CHLORIDE PIPE, AWWA C110 CEMENT MORTAR LINED, AWWA C104	SAME AS GROUP NO. 13
20	POLYVINYL CHLORIDE, SDR35, ASTM 3034	SAME AS GROUP NO. 19	SAME AS GROUP NO. 13
<sup>21</sup> /	HIGH DENSITY POLYETHYLENE PIPE, PROFILE WALL, ASTM F2648, BELL AND SPIGOT	HIGH DENSITY POLYETHYLENE PIPE, ASTM F2306, BELL AND SPIGOT	
22	FIBERGLASS REINFORCED PLASTIC, ASTM D2996 FILAMENT-WOUND, SOCKET AND SPIGOT ENDS, ADHESIVE BONDED	FIBERGLASS REINFORCED PLASTIC, FILAMENT-WOUND, SOCKET ENDS, ADHESIVE BONDED, OR FIBERGLASS FLANGED	PLASTIC LINED, FLANGED. FLANGES TO MATCH 150 PSI ANSI B16.5 DIMENSIONS, OR AS INDICATED ON DRAWINGS
23	POLYVINYL CHLORIDE, SCHEDULE 80, NORMAL IMPACT. ASTM D1785	POLYVINYL CHLORIDE, SCHEDULE 80, NORMAL IMPACT, SOCKET SOLVENT WELD JOINTS, ASTM D2467, OR 150 PSI FLANGED	POLYVINYL CHLORIDE, BALL, DIAPHRAGM, BUTTERFLY, BALL OR LIFT CHECK, NIBCO/CHEMTROL, HILLS-MCCANNA OR R&G SLOAN MFG. CO
24	HIGH DENSITY POLYETHYLENE PIPE, PROFILE WALL, ASTM F2648, BELL AND SPIGOT- PERFORATED WALL	HIGH DENSITY POLYETHYLENE PIPE, ASTM F2306, BELL AND SPIGOT	

FUNCTION					
THIS LIST INCLUDES SOME LINES NOT USED IN THIS PROJECT					
OVERFLOW					
POTABLE WATER					
RESERVOIR DRAIN					
STORM DRAIN					
UNDERDRAIN					

TYPICAL PIPE DESIGNATION:
PIPE MA
2" PW (11)
PIPE DIAMETERFLUID ABBREV
NOTES
GENERAL NOTE ALTHOUGH SEVERAL PIPING MATERIALS ARE BE USED FOR A GIVEN FUNCTION, ONLY THE PIPING MATERIAL SHOWN ON THE CONSTRUCT AND SPECIFICATIONS SHALL BE USED. THE C NOT HAVE THE OPTION TO USE A DIFFERENT
NOTE 1 PROPRIETARY NAMES HAVE BEEN QUOTED FOR IDENTIFICATION PURPOSES ONLY. SUBSTITUTION PERMITTED SUBJECT TO PROVISIONS OF THE NOTE 2
LEAKAGE ALLOWANCE IS AS FOLLOWS: A. PIPES SO DESIGNATED SHALL SHOW ZER B. PIPES SO DESIGNATED SHALL SHOW ZER UNBURIED PIPE AND NOT MORE THAN 0.0 HOUR PER INCH DIAMETER PER 100 FEET
<ul> <li>C. PIPES SO DESIGNATED SHALL NOT SHOW MORE THAN 0.15 GALLON PER HOUR PEF DIAMETER PER 100 FEET OF PIPE.</li> <li>D. PIPE SO DESIGNATED SHALL NOT SHOW / PRESSURE OF MORE THAN 5 PERCENT.</li> <li>E. PIPES SO DESIGNATED SHALL NOT SHOW</li> </ul>
VACUUM OF MORE THAN 4 INCHES MERC NOTE 3 FOR FIELD TEST PROCEDURES AND ADDITION REQUIREMENTS, SEE PIPING SECTION OF SPEC
NOTE 4 ANY DEVIATION FROM THE PIPING MATERIALS REQUIREMENTS SHOWN WILL BE NOTED IN TH OR ON THE DRAWINGS.
NOTE 5 PIPING GROUP NUMBER SHOWN THUS * SHAL SEE PIPING SECTION OF SPECIFICATIONS FOR MATERIALS.
STATIC WATER TEST WITH SURFACE 5 FEET / OF PIPE.
INSPECTION AND TESTING SHALL BE IN ACCC APPLICABLE NATIONAL FIRE PROTECTION ASS STANDARDS.
NO APPARENT LEAKS UNDER NORMAL OPERA
APPLICABLE NATIONAL FIRE PROTECTION ASS STANDARDS. NOTE 10
PIPING MATERIALS SHALL BE IN ACCORDANCE FIRE PROTECTION ASSOCIATION STANDARDS. NOTE 11
FOR VALVES 8 INCHES AND LARGER SEE VAI FOR SPECIAL VALVES SEE SPECIFICATIONS. NOTE 12
CHANGE IN PIPING MATERIALS GROUP NUMBE THUS: $\longrightarrow$ <u>NOTE 13</u>
FOR PIPE LINING AND COATING, SEE SPECIFIC NOTE 14 EXPOSED PIPING SHALL BE PAINTED IN ACCO
SPECIFICATIONS. COLORS TO BE SELECTED B NOTE 15 PIPING MATERIAL SHALL BE NON-ABRASIVE I HOSE AND QUICK CONNECTION COUPLINGS W
NOTE 16 VALVES 2.5 INCH AND SMALLER MAY HAVE S VALVE 3 INCH AND LARGER SHALL HAVE FLA UNLESS OTHERWISE SHOWN OR SPECIFIED.

1		16 16	19 TE			APPR
		3/8/1	4/23/			DATE
IATERIAL						
		'#۱	#2			
EVIATION		SION	SION			z
		RE <	REVI			ESCRIPTIO
E SHOWN THAT MAY HE CALLED OUT HCTION DRAWINGS CONTRACTOR DOES NT MATERIAL.				ORITY		SYM D
FOR TIONS WILL BE E SPECIFICATIONS.				KS AUTHC		
RO LEAKAGE. RO LEAKAGE FOR 0.02 GALLON PER ET OF BURIED PIPE. W A LEAKAGE OF ER INCH OF				WATERWORI Good Water A		
A LOSS OF				NAM		
W A LOSS OF RCURY COLUMN.				g		
NAL TEST PECIFICATION.		Th or	nis worl under i	k was preparea my responsible	l by me control	1
LS OR FIELD TEST THE SPECIFICATIONS			*			
ALL BE INSULATED, DR INSULATING			PROFES	EXP. <u>04/30/19</u> GUAM SS /ONAL ENGINE	\$	
F ABOVE HIGH POINT		CIVIL CIVIL	EN & STRUC RUCTION	GINEER TURAL ENGINEERING, MANAGEMENT & LAN	RS, P PLANNING ND SURVEY	<b>C</b> ;, ing
CORDANCE WITH SSOCIATION						
RATING CONDITIONS.	-		545		011	
CORDANCE WITH SSOCIATION		IF N			NG NG 1" S SHEE	Т.
ICE WITH NATIONAL		AD. DAT SCA	JUST S E: LE:	CALES ACCOF JULY 12, 20 AS SHOWN	RDINGL' 018 1	(
ALVE SCHEDULE.		DES CHE	IGN: CK:	XXTE/JA XXJN		
BER IS INDICATED	L	JRA JOB FILE	WN: #:	XXJA W14-007-BI	ND	
FICATIONS.				ഗ	)	
CORDANCE WITH BY ENGINEER.		JR		JOTE	   	
E FLEXIBLE RUBBER WITH GROUP NO. 1		SERVC	ENT	AND		
E SCREWED ENDS FLANGED ENDS,		<b>A ROSA RE</b>	REPLACEM	CHEDULES		
		SANT <sup>,</sup>	Ľ	PIPING SC		
	S	SHE	ET N	₀. <b>//∩∩1</b>		
			۲۷ 84	OF 12	20	











PANELBOARD "P" SCHEDULE																	
	100A MCB, 208/120V, 3 PHASE, 4 WIRE, 10KAIC MINIMUM, SURFACE MOUNTED																
	L	OAD (V	A)	BKR	WIRE	CKT		LOAD (VA)			СКТ	WIRE	BKR	LOAD (VA)			
LOAD SERVED	А	В	С	TRIP	SIZE	#	Α	E	3	С	#	SIZE	TRIP	Α	В	С	LOAD SERVED
LIGHTING	<mark>51</mark> 2			20/1	#12	1	7			$\sim$	2	#12	20/1	1000			CCTV
PUMP RM RECEPT		360		20/1	#12	3					4	#12	20/1		1500		IP-1
PUMP RM RECEPT			360	20/1	#12	5		_		$\sim$	6	#12	20/1			500	SURGE TANK RECEPT
PUMP CONTROL PANEL	1000			20/1	#12	7	$\neg$	•	-	$\sim$	8		20/1	500			SPARE
SPARE		500		20/1		9				$\sim$	10		20/1		500		SPARE
SPARE			500	20/1		11			-	$\sim$	12		20/1			500	SPARE
SPACE						13	<u>~</u>	•	_	$\sim$	14						SPACE
SPACE						15				$\sim$	16						SPACE
SPACE						17	$\sim$			$\sim$	18						SPACE
	2395					19	<u>-</u>	•		$\sim$	20						SPACE
PANEL A		1900		60/3	#6	21	-^-			$\frown$	22						SPACE
			2495			23	<u> </u>			$\sim$	24						SPACE
TOTAL	3907	2760	3355											1500	2000	1000	TOTAL
	~		10	A = 5	<b>,407</b>	B = 4,7	760 C	) = 4	,355	A	+B+C :	= 14,52	2				·

	PANELBOARD "A" SCHEDULE																
			60A M C	B, 208	120V, 3	PHAS	E, 4 WI	RE, 10	KAIC	: MINI	MUM,	SURFA	CEMC	UNTE	D		
	L	OAD (VA	4)	BKR	WIRE	СКТ		LOAD (VA)		CKT	WIRE	BKR	LOAD (VA)				
LOAD SERVED	А	В	С	TRIP	SIZE	#	Α	В		С	#	SIZE	TRIP	А	В	С	LOAD SERVED
LIGHTING	320			20/1	#12	1	-~-		/	$\sim$	2	#12	20/1	1200			GEN BATTERY
GEN RECEPT		720		20/1	#12	3		+	/	$\sim$	4	#12	20/1		180		ROOF TANK RECEPT
			375	20/2	#10	5	-^-		-•⁄	$\sim$	6	#12	30/1			1620	SUMP PUMP
GENHEATER	375			20/2	#12	7			/	$\sim$	8	#12	20/1	864			DAY TANK PUMP
SPARE		500		20/1		9	$\sim$	+	/	$\sim$	10	#12	20/1		500		FUEL TANK MONITOR
SPARE			500	20/1		11			<b>_</b> •⁄	$\sim$	12		20/1			<mark>500</mark>	SPARE
SPACE						13	-~-			$\sim$	14		20/1	500			SPACE
SPACE						15		+	/	$\sim$	16						SPACE
SPACE						17			<b>_</b> •⁄	$\sim$	18						SPACE
TOTAL	695	1220	875											2564	<mark>680</mark>	2120	TOTAL
A = 3,259 B = 1,900 C = 2,995 A+B+C = 8,154																	

 $\Delta$ 





UTILITY PLAN		¥		
		* * *	(E) FENCE	
				·
ERTY LINE				
EG -				
				· · · · · · · · · · · · · · · · · · ·
<del></del>	······		· l · · · · · · · · · · · · · · · · · ·	<u></u>
		∟ 16″X12' INV=67	7 TEE 6 ±	
	11+00		11+5	0 11+4

	POINT TABLE							
MARK	NORTHING	EASTHING	DESCRIPTION					
P1	670718.80	385733.38	GRAVEL CORNER					
P2	670703.03	385742.04	GRAVEL CORNER					
P3	670678.16	385713.39	GRAVEL CORNER					
P4	670712.58	385694.48	GRAVEL CORNER					
A1	670720.80	385740.65	VAULT A CORNER					
A2	670717.27	385734.22	VAULT A CORNER					
D1	670717.20	385745.82	VAULT D CORNER					
D2	670712.63	385737.69	VAULT D CORNER					

# NOTES:

- BEFORE PURCHASING THE FITTINGS.
- CONDITION AFTER PIPELINE INSTALLATION.
- 2

1. REFER TO SHEET MOO1 FOR PIPING SCHEDULE.

2. THE CONTRACTOR SHALL VERIFY THE DEPTH AND LOCATION OF ALL UTILITY POINT OF CONNECTION IN THE FIELD PRIOR TO START OF CONSTRUCTION AND VERIFY THE SIZE, MATERIAL AND CONNECTION TYPE

3. REFER TO SHEET M701 TO M702 FOR PIPING INSIDE THE VAULTS.

4. CONTRACTOR TO RESTORE GROUND WITHIN DOD PROPERTY TO ORIGINAL

5. CONNECT 1" PRESSURE SUPPLY LINE TO TAPPED BLIND FLANGE. SEE DET 6/C325 & 1/C301. PROVIDE CONTINUOUS POSITIVE SLOPE FROM ALTITUDE VALVE TO TAPPED BLIND FLANGE TO PRECLUDE AIR ENTRAPMENT IN PIPELINE

6. CONNECT 1" PRESSURE SUPPLY LINE TO INLET SIDE OF ALTITUDE  $\triangle$ VALVE AS INDEPENDENT OPERATING PRESSURE.







# NOTES:

- 5. SEE SHEET C300 FOR UTILITY INFORMATION.

## CONSTRUCTION NOTES:

1	3" AC PVMT, SEE I
2	CONFORM TO (E) R
3	RETAINING WALL AN
4	BOLLARD, SEE DET
5	SIDEWALK, SEE DET
6	AB SURFACE, SEE
7	CHAIN LINK FENCE
10	INLET METER VAUL
12	ENERGY DISSIPATOR
13	DITCH, SEE DETAIL
19	DOUBLE SWING GAT SEE DETAIL 3 ON S
22	HEADWALL, SEE DE
23	CONCRETE CURB, S
24	SECURITY CAMERA
25	LIGHT POLE FOUND
26	CONCRETE DRIVEWA
27	CONCRETE HEADER,
28	INSTALL CL FENCE
30	BOLLARD, SEE DET
31	ROCK LINED DITCH,

1. SEE SHEET C102 FOR GEOMETRY COORDINATE DATA.

2. SEE SHEETS C110 AND C111 FOR GEOMETRY, PROFILE AND CROSS SECTIONS FOR PONDING BASIN AND ACCESS ROAD.

3. SEE SHEET C200 FOR DRAINAGE AND GRADING INFORMATION.

4. SEE SHEET C220 FOR PONDING BASIN PLAN AND PROFILE.

6. SEE SHEET C400 AND C401 FOR RETAINING WALL PLAN AND PROFILE.

7. PAVING ADJACENT TO RESERVOIR FOUNDATION SHALL BE INSTALLED NO LESS THAN 14 DAYS AFTER FOUNDATION INSTALLATION IS COMPLETE.

DETAIL 1 ON SHEET C120 ROAD, SEE DETAIL 2 ON SHEET C120 AND CONC GUTTER, SEE SHEET C400 AND C401 TAIL 8 ON SHEET C120 TAIL 5 ON SHEET C120 DETAIL 3 ON SHEET C120 E (W/ BARBED WIRE), SEE SHEET C121 LT, SEE DETAIL 1 ON SHEET C500 OR BOX, SEE DETAIL 1 ON SHEET C231 \_ 2 ON SHEET C230 ATE 12' WIDE (W/ BARBED WIRE), SHEET C121 ETAIL 1 ON SHEET C230 SEE DETAIL 4 ON SHEET C120 SIGN, SEE DETAIL 9 ON SHEET C120 DATION, SEE SHEET C328 AY, SEE SHEET C112 SEE DETAIL 10 ON SHEET C120 ON RETAINING WALL, SEE DETAIL 1 ON SHEET C402 TAIL 8 ON SHEET C120

SEE DETAIL 6 ON SHEET C230 

<u>/2\</u>





## NOTES:

- 5. SEE SHEET C300 FOR UTILITY INFORMATION.

## **CONSTRUCTION NOTES:**

1	3" AC PVMT, SEE
2	CONFORM TO (E) F
3	RETAINING WALL, S
5	SIDEWALK, SEE DE
6	AB SURFACE, SEE
7	CHAIN LINK FENCE
8	20' WIDE DOUBLE S
9	DRAIN VAULT, SEE
11	OUTLET METER VAL
13	DITCH, SEE DETAIL
15	4' WIDE CONC STA
16	(E) BPS BLDG AND
17	CHECK VALVE VAU
18	CONTROL BUILDING
19	DOUBLE SWING GAT SEE DETAIL 3 ON 1
20	MANHOLE, SEE DET
21	TRENCH DRAIN, SE
22	HEADWALL, SEE DE
23	CONCRETE CURB, S
24	SECURITY CAMERA
25	LIGHT POLE FOUND
26	PULL BOX, SEE ELI
27	CONCRETE HEADER
29	HANDRAIL, SEE SHI

1. SEE SHEET C102 FOR GEOMETRY COORDINATE DATA.

2. SEE SHEETS C110 AND C111 FOR GEOMETRY, PROFILE AND CROSS SECTIONS FOR PONDING BASIN AND ACCESS ROAD.

3. SEE SHEET C200 FOR DRAINAGE AND GRADING INFORMATION.

4. SEE SHEET C220 FOR PONDING BASIN PLAN AND PROFILE.

6. SEE SHEET C400 AND C401 FOR RETAINING WALL PLAN AND PROFILE.

7. PAVING ADJACENT TO RESERVOIR FOUNDATION SHALL BE INSTALLED NO LESS THAN 14 DAYS AFTER FOUNDATION INSTALLATION IS COMPLETE.

DETAIL 1 ON SHEET C120 ROAD, SEE DETAIL 2 ON SHEET C120 SEE SHEET C400 AND C401 TAIL 5 ON SHEET C120 DETAIL 3 ON SHEET C120 (W/ BARBED WIRE), SEE SHEET C121 SWING GATE, SEE DETAIL 3 ON SHEET C121 DETAIL 3 ON SHEET C501 AULT, SEE DETAIL 3 ON SHEET C500 AIRS, SEE DETAIL 1 ON SHEET C124 SIDEWALK JLT, SEE DETAIL 1 ON SHEET C501 SEE SHEET C510 TE 14' WIDE (W/ BARBED WIRE), SHEET C121 TAIL 1 ON SHEET C322 EE DETAIL 5 ON SHEET C230 ETAIL 1 ON SHEET C230 SEE DETAIL 4 ON SHEET C120 SIGN, SEE DETAIL 9 ON SHEET C120 DATION, SEE SHEET C328 ECTRICAL SITE PLAN E101 R, SEE DETAIL 10 ON SHEET C120 HEET C124



















AUC	PIPE (SEE NOTE 13)	FITTINGS	VALVE, 6 INCHES AND SMALLER (SEE NOTE 1, NOTE 11 & NOTE 16
<u>J.</u>	STEEL, ASTM A53, SCHEDULE 40, BLACK WELDED	2-INCH AND SMALLER MALLEABLE IRON, ANSI B16.3, THREADED, BANDED, BLACK, 150 PSI OR STEEL, ANSI B16.9, BUTT-WELDED. 3 INCH AND LARGER, CAST IRON, ANSI B16.1, 125 PSI FLANGED OR MECHANICAL COUPLINGS	BRONZE, THREADED, GATE, CRANE NO. 428 UB OR STOCKHAM B-105. GLOBE, STOCKHAM B-37, CHECK, CRANE NO.37 OR STOCKHAM B-139, STEEL, LUBRICATED PLUG, NORDSTORM FIG. 142 OR 143 OR SERCK-AUDCO LSW 144 GG. ECCENTRIC PLUG, DEZURIK SERIES 118 OR KEYSTONE 541. BALL, JAMESBURY FIG 351 OR WATTS NO. B 6080
2	SAME AS GROUP NO. 1	CAST IRON, ANSI B16.12, THREADED, DRAINAGE PATTERN	
3	SAME AS GROUP NO. 1	MALLEABLE IRON, ANSI B16.3, THREADED, BANDED, GALVANIZED, 300 PSI	ECCENTRIC PLUG, DEZURIK SERIES 118 OR KEYSTONE 541. CHECK CRANE 366 E OR MILWAUKEE NO. 544. BALL, JAMESBURY FIG 351 OR WATTS NO. B6080
4	STEEL, ASTM A53, SCHEDULE 40 WELDED, GALVANIZED	2-INCH AND SMALLER MALLEABLE IRON, ANSI B16.3, THREADED, BANDED, GALVANIZED, 150 PSI. 3 INCH AND LARGER, CAST IRON, ANSI B16.1, 125 PSI FLANGED OR MECHANICAL COUPLINGS	2-INCH AND SMALLER, ECCENTRIC PLUG, SYNTHETIC RUBBER FACED, DEZURIK 118S OR KEYSTONE 541. BALL JAMESBURY FIG. 351 OR WATTS NO. B 6080. 3 INCH AND LARGER, ECCENTRIC PLUG, SYNTHETIC RUBBER FACED, DEZURIK 118F OR KEYSTONE 580 GATE, AWWA C500. BUTTERFLY, AWWA, FLANGED
5	SAME AS GROUP NO. 4	MALLEABLE IRON, ANSI B16.3, THREADED, BANDED, GALVANIZED, 300 PSI	BRONZE THREADED, GLOBE, CRANE NO. 212P OR STOCKHAM B-62 OR B-32T. BALL, JAMESBURY FIG 351 OR WATTS NO. B-6080. CHECK, CRANE NO. 27 OR STOCKHAM B-322T
6	STEEL, ASTM A106 OR A53, SCHEDULE 80, SEAMLESS, BLACK	FORGED STEEL, ANSI B16.11, SOCKET WELDED OR THREADED, BLACK, 2000 PSI, OR STEEL, ANSI B16.9, BUTT-WELDED, SCHEDULE 80	CAST IRON, LUBRICATED PLUG, NORDSTORM FIG. 214 OR 305 OR SERCK-AUDCO MSW 544 GG
7	SAME AS GROUP NO. 6	1-INCH AND SMALLER, FORGED STEEL, ANSI B16.11, THREADED OR SOCKET WELDED, BLACK, 3000 PSI WITH FLANGED AMMONIA UNIONS. 1-INCH AND LARGER, STEEL, ANSI B16.9, BUTT-WELDED OR FLANGED, SCHEDULE 80	SEMI-PLUG AND YOKE TYPE OR BALL FOR CHLORINE SERVICE, FORGED CARBON STEEL
8	WELDED STEEL, AWWA C200, UNLINED	WELDED STEEL, FABRICATED, AWWA C200, UNLINED	AS INDICATED ON DRAWINGS
9	STEEL, ASTM A106, OR A53, SCHEDULE 40, SEAMLESS, BLACK	STEEL, ANSI B16.9, BUTT-WELDED. CAST IRON, ANSI B16.1, 125 PSI, FLANGED. FORGED STEEL, SOCKET WELDED, ANSI B16.11, 2000 PSI OR STEEL. ANSI B16.5, 150 PSI FLANGED	CAST IRON, FLANGED, LUBRICATED PLUG, NORDSTORM FIG 143 OR SERCK-AUDCO MSW 133 GG
10	WELDED STEEL, AWWA C200, CEMENT MORTAR LINED & COATED, AWWA C205	WELDED STEEL, AWWA C200, FABRICATED, CEMENT MORTAR LINED & COATED, AWWA C205	AS INDICATED ON DRAWINGS
11 <u>A</u>	WELDED STEEL, AWWA C200, CEMENT MORTAR LINED, AWWA C205, FUSION-BONDED EPOXY COATED, AWWA C213	WELDED STEEL, AWWA C200, FABRICATED, CEMENT MORTAR LINED, AWWA C205, FUSION-BONDED EPOXY COATED AWWA C213	AS INDICATED ON DRAWINGS
12	STAINLESS STEEL, TYPE 316, ASTM A312, SCHEDULE 40S	STAINLESS STEEL, TYPE 316 ANSI B16.3, SCREWED, 150 PSI ANSI B16.9, BUTT-WELDED, SCHEDULE 40S, OR 150 PSI FLANGED	STAINLESS STEEL, BALL, FLANGED, WATTS SERIES 2500 OR JAMESBURY TYPE A/D150F. CHECK, LADISH, NO. 5272 OR CRANE FIG. 377 OR AS SHOWN ON DRAWINGS
13	STEEL ASTM A106 OR A53, SCHEDULE 40, SEAMLESS, BLACK, PVDF OR PTFE LINED.	STEEL, ANSI B16.5, 150 PSI FLANGED, PFDF OR PTFE LINED	CAST STEEL PLUG, DIAPHRAGM OR CHECK 150PSI FLANGED, PVDF OR PTFE LINED
14	DUCTILE IRON, ANSI A21.51, (AWWA C151) OR CAST IRON ANSI A21.6, 150 PSI, BELL AND SPIGOT, MECHANICAL JOINTS, MECHANICAL COUPLINGS, OR 125 PSI FLANGED (TYPICAL SERVICE – WATER LINES)	DUCTILE IRON OR CAST IRON, ANSI A21.10, OR AWWA C110, BELL AND SPIGOT, MECHANICAL COUPLINGS, FLANGED OR MECHANICAL JOINTS, 250 PSI, (PRESSURE RATING) 12 INCHES AND SMALLER, 150 PSI, (PRESSURE RATING) 14 INCHES AND LARGER, WITH 125 PSI ANSI B16.1 FLANGES.	GATE, AWWA C500, 'O' RING SEALS, MECHANICAL JOINT ENDS, MUELLER A-2380-20, OR CLOW F-5065. BUTTERFLY, AWWA. ECCENTRIC PLUG, DEZURIK SERIES 118 OR KEYSTONE 541, BALL, PRATT OR APCO-WILLAMETTE
15	COPPER, ASTM B88, TYPE K, SOFT TEMPERED WHERE BURIED, HARD TEMPERED WHERE EXPOSED	WROUGHT COPPER OR CAST BRONZE, ANSI B16.22, SOLDER JOINT, 150 PSI, OR COMPRESSION FITTINGS. (FOR OXYGEN PIPING USE SILVER SOLDER, FOR COMPRESSED AIR AIR PIPING USE 95-5 TIN-ANTIMONY SOLDER)	BRONZE, SOLDER JOINT, GLOBE, CRANE NO. 1310 OR STOCKHAM B-14T. CHECK, CRANE NO. 1342 OR 36, OR STOCKHAM B-309 OR B-345, GATE, CRANE NO. 426, OR STOCKHAM B-104 OR B-105
16	REINFORCED CONCRETE, ASTM C76, TONGUE AND GROOVED JOINTS. (TYPICAL SERVICE-CULVERTS)	SAME AS GROUP NO. 10	
17	REINFORCED CONCRETE, AWWA C302, CLASS-SEE DRAWINGS. (TYPICAL SERVICE - PRESSURE PIPELINES)	SAME AS GROUP NO. 10	AS INDICATED ON DRAWINGS
18	POLYVINYL CHLORIDE, SCHEDULE 80, NORMAL IMPACT. ASTM D1785-PERFORATED WALL	POLYVINYL CHLORIDE, SCHEDULE 80, NORMAL IMPACT, SOCKET SOLVENT WELD JOINTS, ASTM D2467	POLYVINYL CHLORIDE, BALL, DIAPHRAGM, BUTTERFLY, BALL OR LIFT CHECK, NIBCO/CHEMTROL, HILLS-MCCANNA OR R&G SLOAN MFG. C
19	POLYVINYL CHLORIDE PRESSURE PIPE ASTM D2241 WITH BELL AND SPIGOT JOINTS	CAST IRON, 150 PSI, FOR POLYVINYL CHLORIDE PIPE, AWWA C110 CEMENT MORTAR LINED, AWWA C104	SAME AS GROUP NO. 13
20	POLYVINYL CHLORIDE, SDR35, ASTM 3034	SAME AS GROUP NO. 19	SAME AS GROUP NO. 13
21	HIGH DENSITY POLYETHYLENE PIPE, PROFILE WALL, ASTM F2648, BELL AND SPIGOT	HIGH DENSITY POLYETHYLENE PIPE, ASTM F2306, BELL AND SPIGOT	
22	FIBERGLASS REINFORCED PLASTIC, ASTM D2996 FILAMENT-WOUND, SOCKET AND SPIGOT ENDS, ADHESIVE BONDED	FIBERGLASS REINFORCED PLASTIC, FILAMENT-WOUND, SOCKET ENDS, ADHESIVE BONDED, OR FIBERGLASS FLANGED	PLASTIC LINED, FLANGED. FLANGES TO MATCH 150 PSI ANSI B16.5 DIMENSIONS, OR AS INDICATED ON DRAWINGS
23	POLYVINYL CHLORIDE, SCHEDULE 80, NORMAL IMPACT. ASTM D1785	POLYVINYL CHLORIDE, SCHEDULE 80, NORMAL IMPACT, SOCKET SOLVENT WELD JOINTS, ASTM D2467, OR 150 PSI FLANGED	POLYVINYL CHLORIDE, BALL, DIAPHRAGM, BUTTERFLY, BALL OR LIFT CHECK, NIBCO/CHEMTROL, HILLS-MCCANNA OR R&G SLOAN MFG. C
24	HIGH DENSITY POLYETHYLENE PIPE, PROFILE WALL, ASTM F2648, BELL AND SPIGOT- PERFORATED WALL	HIGH DENSITY POLYETHYLENE PIPE, ASTM F2306, BELL AND SPIGOT	

FLUID ABBREVIATION	FUNCTION THIS LIST INCLUDES SOME LINES NOT USED IN THIS PROJECT							
OF	OVERFLOW							
PW	POTABLE WATER							
RD	RESERVOIR DRAIN							
SDR	STORM DRAIN							
UD	UNDERDRAIN							

TYPICAL PIPE DESIGNATION:
/ PIPE MA
2" PW (11)
PIPE DIAMETER —
NOTES
GENERAL NOTE
BE USED FOR A GIVEN FUNCTION, ONLY THE
AND SPECIFICATIONS SHALL BE USED. THE OPTION TO USE A DIFFERENT
NOT HAVE THE OF HON TO USE A DIFFERENT NOTE 1 DEODRIFTARY NAMES HAVE REEN QUOTED FO
IDENTIFICATION PURPOSES ONLY. SUBSTITUTION PERMITTED SUBJECT TO PROVISIONS OF THE
<u>NOTE 2</u> LEAKAGE ALLOWANCE IS AS FOLLOWS:
A. PIPES SO DESIGNATED SHALL SHOW ZER B. PIPES SO DESIGNATED SHALL SHOW ZER
UNBURIED PIPE AND NOT MORE THAN 0. HOUR PER INCH DIAMETER PER 100 FEE
C. PIPES SO DESIGNATED SHALL NOT SHOW MORE THAN 0.15 GALLON PER HOUR PER
DIAMETER PER 100 FEET OF PIPE. D. PIPE SO DESIGNATED SHALL NOT SHOW
PRESSURE OF MORE THAN 5 PERCENT. E. PIPES SO DESIGNATED SHALL NOT SHOW
VACUUM OF MORE THAN 4 INCHES MERC
FOR FIELD TEST PROCEDURES AND ADDITION REQUIREMENTS, SEE PIPING SECTION OF SPE
NOTE 4 ANY DEVIATION FROM THE PIPING MATERIALS
REQUIREMENTS SHOWN WILL BE NOTED IN THOR ON THE DRAWINGS.
NOTE 5 PIPING GROUP NUMBER SHOWN THUS * SHAL
MATERIALS.
STATIC WATER TEST WITH SURFACE 5 FEET
NOTE 7 INSPECTION AND TESTING SHALL BE IN ACCO
APPLICABLE NATIONAL FIRE PROTECTION ASS STANDARDS.
NOTE 8 NO APPARENT LEAKS UNDER NORMAL OPERA
NOTE 9 INSPECTION AND TESTING SHALL BE IN ACCO
APPLICABLE NATIONAL FIRE PROTECTION ASS STANDARDS.
NOTE 10 PIPING MATERIALS SHALL BE IN ACCORDANC
FIRE PROTECTION ASSOCIATION STANDARDS. NOTE 11
FOR VALVES 8 INCHES AND LARGER SEE VA FOR SPECIAL VALVES SEE SPECIFICATIONS.
CHANGE IN PIPING MATERIALS GROUP NUMBE
$\frac{1}{1003} \longrightarrow \frac{1}{100}$
NOTE 14 EXPOSED DIDING SHALL BE DAINTED IN ACCO
SPECIFICATIONS. COLORS TO BE SELECTED B
PIPING MATERIAL SHALL BE NON-ABRASIVE HOSE AND QUICK CONNECTION COUPLINGS W
AT EQUIPMENT. NOTE 16
VALVES 2.5 INCH AND SMALLER MAY HAVE VALVE 3 INCH AND LARGER SHALL HAVE FL
UNLESS OTHERWISE SHOWN OR SPECIFIED.

	3/19 TE 3/19 TE	APPR
PF MATERIAI	3/6	
ABBREVIATION	sion #1 sion #2	
	REVIS	ESCRIPTION
S ARE SHOWN THAT MAY LY THE CALLED OUT ISTRUCTION DRAWINGS THE CONTRACTOR DOES FERENT MATERIAL.	$\overline{\mathbb{A}}$	CRITY SYM D
OTED FOR STITUTIONS WILL BE OF THE SPECIFICATIONS.		Liways
W ZERO LEAKAGE. W ZERO LEAKAGE FOR HAN 0.02 GALLON PER DO FEET OF BURIED PIPE. SHOW A LEAKAGE OF UR PER INCH OF		WATERWORK Good Water A
SHOW A LOSS OF CENT.		NAM
SHOW A LOSS OF 5 MERCURY COLUMN.	This wor	
DEFINITIONAL TEST DF SPECIFICATION.	or under i	my responsible control
ERIALS OR FIELD TEST IN THE SPECIFICATIONS	*	No 1851 CIVIL
* SHALL BE INSULATED, NS FOR INSULATING	Page 1	EXP. 04/30/19 GUAN SS IONAL ENGINE
FEET ABOVE HIGH POINT	TG EN CIVIL & STRUC CONSTRUCTION	GINEERS, PC TURAL ENGINEERING, PLANNING, MANAGEMENT & LAND SURVEYING
N ACCORDANCE WITH ON ASSOCIATION		
OPERATING CONDITIONS.	BAR	IS ONE INCH ON
N ACCORDANCE WITH ON ASSOCIATION		SINAL DRAWING 1" INCH ON THIS SHEET, CALES ACCORDINGLY
RDANCE WITH NATIONAL ARDS.	DATE: SCALE:	OCT 12, 2018 AS SHOWN
SEE VALVE SCHEDULE. IONS.	DESIGN: CHECK: DRAWN <sup>.</sup>	XTKE/JA XJKN XIKA
NUMBER IS INDICATED	JOB #: FILE:	W14-007-BND
SPECIFICATIONS.	ENT	ES
N ACCORDANCE WITH CTED BY ENGINEER.	CEMI	NOT
ASIVE FLEXIBLE RUBBER INGS WITH GROUP NO. 1	REPLA	S AND
HAVE SCREWED ENDS AVE FLANGED ENDS, FIED.	RVOIR F	1EDULES
	RESE	G SCF
	<b>NIFA</b>	PIPIN(
	SHEET N	0.
	69 69	/IUU1 OF 93



















			LIGHT FIXTURE SCHEDULE	
SYMBOL	LAMP	VOLTS	DESCRIPTION	
A	2-32W T8	MVOLT	HOUSING FORMED FROM IMPACT RESISTANT, UV STABILIZED, FIBERGLASS REINFORCED POLYES-TER WITH COLD-ROLLED STEEL ENCLOSED WIREWAY.	L M C
C1	1-95W LED	MVOLT	LED, 4000K, TYPE IV DISTRIBUTION, MVOLT, SINGLE ARM	L
C2	2-95W LED	MVOLT	LED, 4000K, TYPE IV DISTRIBUTION, MVOLT, TWIN ARM	L

NEW PANELBOARD "P" SCHEDULE														
	60	АМСВ,	, 208/12	20V, 3 P	HASE,	4 WIRE	i, 104		NIMUN	I, SUR		ΙΟυΝΤ	ED	
	LOAD (VA)		BKR	WIRE	СКТ	LOAD (VA)		CKT	WIRE	BKR	LOAD (VA)			
LOAD SERVED	А	В	TRIP	SIZE	#	Α		В	#	SIZE	TRIP	A	В	LUAD SERVED
RECEPTACLE	540		20/1	#12	1		_	ረ	2	#12	20/1	400		LIGHTING
CCTV CAB		720	20/1	#12	3			ζ	4	#12	20/1		300	LIGHTING
IP-1			20/1	#12	5			4	6	#12	20/1	<mark>18</mark> 0		TANK ROOF RECEP
SPARE			20/1		7			7	8		20/1			SPARE
SPARE			20/1		9	<b>~</b>		ረ	10		20/1			SPARE
SPARE			20/1		11			2	12					SPACE
SPARE			20/1		13			4	14					SPACE
SPACE					15	<u> </u>		ζ	16					SPACE
SPACE					17		<b>_</b>	4	18					SPACE
TOTAL	540	720										580	300	TOTAL
				A = 1,1	20 B	= 1,02	0	A+	B = 2,1	40				

