AMERICAN SAMOA POWER AUTHORITY

STANDARD WATER TANK SPECIFICATIONS

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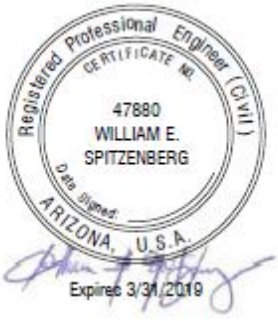

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SECTION 00400

POTABLE WATER STORAGE TANK - WELDED STEEL

PART 1 - GENERAL

1.1 Section Includes

1.1.1 This section includes furnishing and erecting a 320,000 gallons capacity welded steel Storage Tank and necessary piping and appurtenances, per AWWA D100 specifications, latest revision.

1.2 Qualifications of Tank Supplier

1.2.1 The Engineer's selection of a welded steel tank is predicated on a thorough examination of design criteria, construction methods, and optimum coating for resistance to internal and external tank corrosion. Deviations from the specified design, construction or coating details will not be permitted.

1.2.2 The bidder shall offer a new tank reservoir as supplied from a manufacturer specializing in the design, fabrication and erection of welded storage tanks.

1.2.3 The tank shown on the contract drawings and specified herein shall be fabricated by CB & I or approved equal.

1.2.4 Erection of the tank is to be by the tank manufacturer or approved contractor. The installer shall by fully responsible for the entire installation including tank erection, and the ultimate water tightness of the complete installation.

1.2.5 Strict adherence to the standards of design, fabrication, erection, product, quality, and long-term performance, established in the Specification will be required by the Owner and Engineer.

1.2.6 Tank suppliers wishing to pre-qualify shall submit the following to the Engineer/Owner for consideration:

1.2.6.1 List of tank materials, appurtenances and tank coating technical specifications.

1.2.6.2 Resume of job installation superintendent.

1.2.6.3 The contractor shall have the experience and knowledge necessary to furnish and erect the highest quality tank possible. Under no circumstances shall an inexperienced contractor be awarded the project. The contractor shall be fully responsible for the installation including appurtenances and the final product.

1.2.6.4 The components of the tank that come in contact with stored water shall be certified to meet ANSI/NSF Additives Standard No. 61.

1.3 Submittal Drawings and Specification

1.3.1 Construction shall be governed by the Owner's drawings and specifications showing general dimensions and construction details. There shall be no deviation from the drawings and specifications, except upon written order from the Engineer.

1.3.2 The bidder is required to furnish, for the approval of the Engineer and at no increase in contract price, 5 sets of complete specifications and construction drawings stamped by a U.S. registered structural engineer for all work not shown in complete detail on the bidding drawings. A complete set of structural calculations shall be provided for the tank structure and foundation.

1.3.3 When approved, two sets of such prints and submittal information will be returned to the bidder marked "APPROVED FOR CONSTRUCTION" and these drawings will then govern the work detailed thereon. The approval by the Engineer of the tank supplier's drawings shall be an approval relating only to their general conformity with the bidding drawings and specifications and shall not guarantee detail dimensions and quantities, which remains the bidder's responsibility.

PART 2 – DESIGN CRITERIA

2.1 Tank Size

2.1.1 The welded tank shall have a diameter of 48 ft. with a nominal sidewall height (to roof eave) of 28.6 ft. (see Dwg.ID: C2).

2.2 Tank capacity and elevation

2.2.1 Tank working capacity shall be 320,000 gallons (nominal).

2.2.2 Freeboard space in top shall be a minimum of 4.4 ft.

2.2.3 Tank base elevation shall be at 272.62 ft.

2.3 Tank Design Requirements

2.3.1 The materials, design, fabrication and erection of the welded tank shall conform to AWWA Standard D100, latest edition.

2.3.2 The welded steel reservoir will rest on an oiled sand base contained by a concrete ring-wall foundation.

2.3.3 The reservoir shall be furnished with piping and appurtenances as shown on the plans and as follows:

2.3.3.1 Inlet Pipe

2.3.3.2 Overflow pipe

2.3.3.3 Outlet pipe

2.3.3.4 Drain pipe

2.3.3.5 30" square, hinged, lockable roof hatch

2.3.3.6 Two shell manholes with hinged covers

2.3.3.7 Outside ladder with ladder gate and lock, and fall protection

2.3.3.8 Inside ladder without fall protection

2.3.3.9 Screened roof vent

2.3.3.10 Level indicator

2.3.3.11 Identification name plate

2.3.4 The steel tank shall be designed in accordance with Section 3 of AWWA D100. **Section 14 shall not be used**.

PART 3 - MATERIALS

3.1 Manufacturers

3.1.1 All materials shall be certified as American Made or approved equal.

3.2 Tank Materials

3.2.1 Furnish steel plate and structural shapes per AWWA D100, Section 2.

3.2.2 Steel pipe and pipe fittings shall conform to ASTM A-120.

3.2.3 Structural bolts shall conform to ASTM A-307.

3.2.4 Welding electrodes shall conform to ASTM 233 E60 or E70.

3.2.5 Asphalt board or asphalt expansion joint material shall be furnished which complies with ASTM D-994

3.2.6 Caulking mastic shall be 100% solids epoxy or approved equal.

PART 4 - COATINGS

4.1 Interior Coating System

4.1.1 All coatings that are in contact with potable water must be certified and on the current approved list of the National Sanitation Foundation to meet ANSI/NSF Additives Standard No. 61.

4.1.2 Interior coating system, including coating manufacturer brand name and average DFT (dry film thickness/mils) to be as specified in bid documents.

4.2 Exterior Coating System

4.2.1 Exterior coating system, including manufacturer brand name and average DFT (dry film thickness/mils) to be as specified in bid documents.

PART 5 - FABRICATION

5.1 Tank Fabrication

5.1.1 All reservoir sub-assemblies and accessories, including shell manholes ladders, and overflow pipes, shall be fabricated in accordance with AWWA D-100, Section 7.

5.1.2 All exterior ladders, guard rails, brackets, hatch covers, pins and fasteners shall be steel that is hot dipped galvanized per ASTM A123/153 after fabrication.

5.1.3 Welded steel deck assembly per AWWA D100.

5.2 Appurtenances

5.2.1 Pipe Connections

5.2.1.1 Overflow piping shall be 8 inches nominal diameter schedule 10 carbon steel coated externally. A 90 degree internal weir elbow with external downcomer pipe and flap valve shall be provided for the overflow.

5.2.1.2 Inlet and outlet connections shall conform to the sizes and locations specified on the plan sheets.

5.2.2 Tank Ladders

5.2.2.1 An outside and inside tank ladder shall be furnished and installed as shown on the contract drawings

5.2.2.2 Safety cage and step-off platforms shall be fabricated of aluminum or stainless steel or similar material as tank to prevent dissimilar metal corrosion. Ladders shall be equipped with a hinged lockable entry device.

5.2.3 Access Doors

5.2.3.1 Two man ways shall be provided as shown on the contract drawings in accordance with AWWA D100.

5.2.3.2 The manhole opening shall be a minimum of 24 inches in diameter. The access door (shell manhole) and the tank shell reinforcing shall comply with AWWA D100.

5.2.4 Roof Vent

5.2.4.1 A properly sized vent assembly in accordance with AWWA D100 shall be furnished and installed above the maximum water level of sufficient capacity so that at maximum design rate or water fill or withdrawal, the resulting interior design pressure / vacuum will not exceed +2.0 / -0.5 ounces per square inch.

5.2.4.2 The overflow pipe shall not be considered to be a tank vent.

5.2.4.3 The vent shall be so designed in construction as to prevent the entrance of birds and/or animals by including a 4 mesh (1/4" opening size) galvanize screen and a 16 mesh (1/16" opening size) galvanized screen installed to prevent the entrance of insects.

5.2.5 Roof Hatch

5.2.5.1 The manufacturer shall furnish a roof opening which shall be placed near the outside tank ladder and which shall be provided with a hinged cover and a hasp for locking. The opening shall have a clear dimension of at least thirty (30) inches square. The opening shall have a curb, at least four (4) inches in height and the cover shall have a downward overlap of at least two (2) inches.

5.2.6 Roof Perimeter Guardrail

5.2.6.1 Perimeter guardrail and toe board around the perimeter of the deck shall be provided and installed as specified on the project drawings.

5.2.7 Liquid Level Indicator

5.2.7.1 A liquid level indicator with stainless steel float, number board and high visibility target shall be provided and installed as detailed on the project drawings.

5.2.8 Identification Plate

5.2.8.1 Manufacturer's nameplate shall list the **tank serial number,** tank diameter and height, date of erection, name of manufacturer and contractor, and maximum design capacity. The nameplate shall be affixed to the tank exterior sidewall location approximately five (5) feet from the grade elevation.

5.3 ACCESSORIES

5.3.1 Water Flow Meter

5.3.1.1 The flow meters shall be propeller turbine type furnished with fabricated carbon steel body, injection molded thermoplastic propeller and 12 to 15 mil NSF approved fusion bonded epoxy faced and drilled Class 150 ANSI or JIS flanged ends and shall be designed for 150 psi working pressure. Flow meter size shall be of the same size as indicated in the drawings. The meter body shall have the same nominal inside diameter throughout its length and shall be furnished with non-toxic liners. The meter accuracy shall register within plus or minus 1.5% or better of actual flow at normal flows and plus or minus 1.5% or better of low flow and shall have 6 digits totalizer. Registration shall be in 1,000s gallons. Sweep hand shall revolve once per 1,000 gallons. Meter shall be Sensus T2 or approved equal and conform to AWWA C701.

5.3.2 Altitude Valves

5.3.2.1 Altitude valves shall be of the hydraulically operated, pilot controlled, single seated, diaphragm type, globe valves (with resilient disc) and shall control the high water level in tanks and reservoirs without the need for floats or other devices. It shall be a non-throttling type valve and remain fully open until the "shut-off" point in the tank or reservoir is reached. The valve shall be designed as a two-way or one-way as shown in the drawings. The valve shall be manufactured by Cla-Val Co. or approved equal.

PART 6 - EXECUTION

6.1 Earthwork

6.1.1 All excavation, structural fill, and structural backfill in connection with foundation preparation and construction shall be done according to the requirements of the drawings and of contract documents. All trench excavation, pipe laying, and pipe bedding and backfill shall be done according to the requirements of the drawings and specifications.

6.2 Concrete

6.2.1 All concrete work for reservoir foundations and floor slabs shall be done according to contract documents.

6.3 Field Examination

6.3.1 The tank fabricator shall field verify the foundation elevation and the tolerances of the in-place foundation. Any deviations shall be reported to the Engineer for correction before proceeding with any work. All tank piping must be in place prior to the commencement of tank erection.

6.4 Tank Erection

6.4.1 The contractor shall furnish all labor, tools, scaffolding, and other equipment necessary to properly erect the tank complete and ready for use.

6.4.2 Erection shall be completed in compliance with Section 10 of AWWA D100 for welded steel tanks.

6.5 Field Quality Control Testing

6.5.1 After the erection of the reservoir is completed and before it is painted, it shall be tested for leaks. Any leaks that are disclosed in the shell bottom, roof, manhole, or piping shall be repaired prior to painting.

6.5.2 Inspection and testing shall be in accordance with Section 11 of AWWA D100, latest revision.

6.5.3 All defective welds shall be removed and repaired in accordance with Section 11 of AWWA D100, latest revision

6.5.4 Make available all radiographs and other testing information to the Owner's representative during construction.

6.5.5 After completion of the work, the Contractor shall submit a written report and certification that all work has been inspected and tested and is in accordance with all applicable provisions of AWWA D100, latest revision.

6.5.6 All costs associated with testing shall be paid by the Contractor.

6.6 Qualifications For Tank Manufacturers And Tank Erectors **(Require information to be submitted with Contractor's bid)**:

6.6.1 Tank Manufacturer: Company specializing in the fabrication of welded steel water tanks. All uncoiling, rolling and furnace operations shall be at one location. The manufacturer shall have fabricated and supplied, at least, ten (10) welded steel tanks of comparable or larger capacity in the past 12 months. Provide a list of current year tanks shipped, with the owner's name, contact persons and phone numbers. This information shall be provided with bid.

6.6.2 Tank Erector: Company specializing in performing erection of welded steel tanks shall have successfully erected a minimum of ten (10) comparable diameter or larger welded steel tanks presently in full operational service in the United States. Provide a list complying tanks, owners' name, contact person and phone numbers. This information shall be provided with bid.

6.6.3 Installation Crew: Installation of the tank shall be under the direction of the tank erector's factory certified tank builder and shall maintain the same foreman and crew from start to finish of work unless change is approved by Manager. Provide the names of the factory certified tank builders for each of the 10 tanks listed above. This information shall be provided with bid.

PART 7 - DISINFECTION

7.1 Standards

7.1.1 The tank structure shall be disinfected at the time of testing in accordance with AWWA Standard C652-02 "Disinfection of Water Storage Facilities" using chlorination method number two.

PART 8 – TANK MANUFACTURER'S WARRANTY

8.1 The tank manufacturer shall include a warranty on tank materials and workmanship for a specified period. As a minimum, the warranty shall provide assurance against defects in material, coatings and workmanship for a period of ten (10) years.

PART 9 – ADDITIONAL REQUIREMENTS FOR WELDED STEEL TANKS

9.1 The steel tank be designed in accordance with Section 3 of AWWA D100. Section 14 shall not be used.

9.2 Per AWWA D100 – Foreword, Section III.A.2 Item 19 a corrosion allowance of a 1/8" for the steel plate for the floor wall and roof.

9.3 Per AWWA D100 – Foreword, Section III.A.2 Item 31 seal welds shall be required for all lap splices.

9.4 Per AWWA D100 - a knuckle roof with a 3' radius shall be required.

9.5 The interior coating system shall be installed per AWWA D102 – System ICS-5, thickness for each coat shall be a minimum of 150% per AWWA D100 Section 4.4.6.2, prepare surface to SSPC-SP 10/NACE No. 2.

9.6 The exterior coating system shall be installed per AWWA D102 – System OCS-6, thickness for each coat shall be a minimum of 150% per AWWA D100 Section 4.3.7.2, prepare surface to SSPC-SP 10/NACE No. 2.

9.7 Each coat shall be a different color.

9.8 Coating and inspection and testing shall be performed per AWWA D102 – Section 5.1 and the recommendations of AWWA D102 Appendix A by a NACE certified inspector.

9.9 Dehumidification and climate control for the interior coating application shall be required.

9.10 The tank shall be inspected at the 1 year and 3 year anniversaries after acceptance of the tank. Remedial work shall be performed per AWWA D102 Section 5.2.3 at no cost to the owner.

END OF SECTION

SECTION 00410

POTABLE WATER STORAGE TANK - BOLTED STEEL

PART 1 – GENERAL

1.01 SCOPE OF WORK

This section includes furnishing and erecting a RTP (rolled, tapered panel) bolted steel reservoir and all necessary piping and appurtenances, per AWWA D-103 specifications. For tank replacement projects, the contractor shall demolish the existing tank and preserve the existing foundation to be used for the new tank if suitable.

1.02 DRAWINGS AND SPECIFICATIONS

A. Construction shall be governed by the Owner's drawings and specifications showing general dimensions and construction details. There shall be no deviation from the drawings and specifications, except upon written order from the Engineer.

B. The bidder is required to furnish, for the approval of the Engineer and at no increase in contract price, 5 sets of complete specifications and construction drawings for all work not shown in complete detail on the bidding drawings stamped by a U.S. licensed Professional Engineer. A complete set of structural calculations shall be provided for the tank structure and foundation stamped by a USA licensed Professional Structural Engineer.

C. When approved, two sets of such prints and submittal information will be returned to the bidder marked **"APPROVED FOR CONSTRUCTION"** and these drawings will then govern the work detailed thereon. The approval by the Owners Engineer of the tank supplier's drawings shall be an approval relating only to their general conformity with the bidding drawings and specifications and shall not guarantee detail dimensions and quantities, which remains the bidder's responsibility.

1.03 MEASUREMENT AND PAYMENT

Payment shall be based on the items as shown in the bid form which may be classified either as unit bid items or lump sum items.

1.04 QUALIFICATION OF TANK SUPPLIER

A. The Engineer's selection of a Fusion Bond powder coated bolted steel tank is predicated on a thorough examination of design criteria, construction methods, and optimum coating for resistance to internal and external tank corrosion. Deviations from the specified design, construction or coating details will not be permitted.

B. The bidder shall offer a new tank structure as supplied from a manufacturer specializing in the design, fabrication and erection of factory applied Fusion Bond coated, bolt together tank systems. The manufacturer shall fabricate and coat the tank in the same facility, which it owns and operates.
C. The tank shown on the contract drawings and specified herein shall be a LIQ Fusion 7000 FBE™ powder-coated, RTP bolted tank as manufactured by Tank Connection or other approved manufacturer.
D. Erection of the structure is to be by the tank manufacturer. The contractor shall be fully responsible for the entire installation including tank erection, and the ultimate water tightness of the complete installation.
E. Strict adherence to the standards of design, fabrication, erection, product, quality, and long-term performance, established in this Specification will be required by the Owner and Engineer.
F. Tank suppliers wishing to pre-qualify shall submit the following to the Engineer/Owner for consideration:
    a. Typical structure drawing(s)
    b. List of tank materials, appurtenances and tank coating technical specifications.
    c. Resume of job installation superintendent.
    d. The contractor shall have the experience and knowledge necessary to furnish and erect the highest quality tank possible. Under no circumstances shall an inexperienced contractor be awarded the project. The contractor shall be fully responsible for the entire installation including appurtenances and the final product.
    e. If an aluminum geodesic dome roof system is required, the dome erector must have installed, and had in satisfactory service, at least one clear span aluminum dome with a diameter equal to or larger than the unit specified, and shall submit evidence of such with his bid proposal and/or pre-bid submittal.
    f. The components of the tank that come in contact with stored water shall be certified to meet ANSI/NSF Additives Standard No. 61.

1.05 DESIGN CRITERIA

A. The materials, design, fabrication and erection of the bolt together tank shall conform to the AWWA Standard for "Factory-Coated Bolted Steel Tanks For Water Storage" – ANSI/AWWA D103, latest addition.
B. The tank coating system shall conform solely to Section 10.6 Thermoset Powder Coatings of ANSI/AWWA D103, latest addition.
C. All materials furnished by the tank manufacturer, which are in contact with stored water, shall be certified to meet ANSI/NSF Additives Standard No. 61. Certification of a coating type alone will not be sufficient to meet this requirement. Certification of a distributor, and not the tank or coating manufacturer, will not be accepted.

D. The RTP (rolled, tapered panel) bolted tank design shall have lap joint connections on both vertical and horizontal shell seams. American Petroleum Institute (API 12B) flanged panel tank design will not be acceptable.
E. The following information is provided for the proper design of the tank:

Job Site Location:	Upper Amouli area (see Dwg.ID: G1)
Product to be stored:	Drinking water
Specific Gravity:	1
PH of Product:	6.8~7.5
Temperature of Product:	23~35˚C
Nominal Capacity (Gallons):	320,000
Nominal Diameter (Feet):	48
Nominal Height (Feet):	28.6
Tank Base Elevation (Feet):	272.62
Min. Freeboard Space (Feet):	4.4
Design Pressure:	Atmospheric
Deck Live Load:	25 psf
Wind Speed:	200 mph
Seismic Zone:	3

1.06 REFERENCES

AWWA D103-97 – Bolted steel tank fabrication and erection

AWWA C652 – Disinfection of Water Storage Facilities

AWWA D102 – Standard for Painting Steel Water Storage Tanks

ANSI- American National Standards Institute

ASTM- American Society of Testing Of Material

SSPC- Steel Structure Painting Council

NSF- Additives Standard No. 61

NSF- Additives Standard No. 60

1.07 DESIGN SUBMITTALS FOR REVIEW

After award of the contract but prior to the start of any construction activity, the contractor shall submit five (5) complete sets of shop drawings and calculations to the Owner for approval.
All shop drawings and design calculations shall be certified by a United States Professional Civil Engineer.
Shop Drawings:

1) Storage Tank: Tank height and diameter, plate thickness and material requirements, structural details, weld joint details, anchor bolt and tank tie-down details (if applicable)and tank accessories details. Include erection drawings, elevations, and details where applicable. Submit paint color charts to the Owner for selection of inside and outside tank colors.
2) Foundation: Show size and location of all structural elements and reinforcements and type and location of splices of reinforcement.
3) Design Calculations: All calculations shall clearly state the external loading criteria and assumptions; show the resulting moments and stresses; and detail resulting cross-section area. The design calculations shall be provided by the Supplier/Contractor.

No deviation will be made from the approved submittal drawings without written approval from the Owner.

PART 2 – MATERIAL SPECIFICATIONS

2.01 STEEL

A. Plates and sheets used in the construction of the tank shell, tank floor and tank roof, shall comply with the minimum standards of AWWA D103. Design requirements for plate and sheet steel shall be ASTM A36; or ASTM A1011 Grade 40, 50, 60; or A572 Grade 50, 60; or A656 Grade 50, 60 or 70 with minimum yield strength of 40,000 psi. Minimum thickness shall be 3/16 inch (0.1875 inches).
B. Rolled Structural Shapes: Rolled structural shapes shall conform to ASTM A36, A572 Grade 50, A992 or ANSI 1010. Other grades of carbon steel that meet or exceed these standards may be utilized.

2.02 BOLTS

A. Bolts used in tank lap joints shall be ½ - 13 UNC-2A rolled thread, and shall meet the minimum requirements of AWWA D103, Section 4.2.
B. Bolt material shall be SAE J429 Grade 8 150,000 psi min.
C. Bolt Finish – JS500 electro-plated.
D. Bolt Head Encapsulation

1. High impact polypropylene copolymer encapsulation of entire bolt head up to the splines on the shank.
2. Resin shall be stabilized with an ultraviolet light resistant material such that the color shall appear black. The bolt head encapsulation shall be certified to meet the ANSI/NSF Standard 61 for indirect additives.

E. All bolts on the vertical tank wall shall be installed such that the head portion is located inside the tank, and the washer and nut are on the exterior.
F. Bolt lengths shall be sized to achieve a neat and uniform appearance. Excessive threads extending beyond the nut after torquing will not be permitted.
G. Other bolts shall conform to or at least be equal to the latest revision of ASTM A307 or ASTM A325.
H. Anchor bolts shall meet or exceed the requirements of ASTM A36 or ASTM A325.

2.03 GASKET & SEALANTS

A. The lap joint sealant shall be a one component, moisture cured, polyurethane compound. The sealant shall be suitable for contact with potable water and shall be certified to meet ANSI/NSF Additives Standard 61 for indirect additives.
B. The sealant shall be used to seal lap joints and bolt connections and edge fillets for sheet notches and starter sheets. The sealant shall cure to a rubberlike consistency, have excellent adhesion to the Fusion Bond coating, low shrinkage, and be suitable for interior and exterior use.
C. Sealant curing rate at 73°F and 50% RH
D. Tack-free time: 6 to 8 hours
E. Final cure time: 10 to 12 hours
F. Neoprene gaskets and tape type sealer shall not be used in liquid contacting surfaces.

2.04 COATING

All metal plates, supports, members, and miscellaneous parts, except bolts, certain accessories, and appurtenances, shall be factory coated in accordance with AWWA D102 and the provisions of these specifications. Field coating, except for touch-up will not be permitted. The color of the external surface shall be forest green.

2.05 APPLICATION PROCEDURES FOR FACTORY COATING

A. Cleaning
    1. Following the fabrication process, sheets and tank components shall be thoroughly washed and rinsed.

a. Washing shall be with DuBois 626 E detergent (or equivalent). Concentration shall be 2% to 3% and the water temperature shall be 130 to 140 degrees F.
b. The PH level shall be monitored and maintained at 10 to 12.
c. Rinsing shall be in a two stage booth and ambient temperature fresh water in the second stage.
d. All water shall be removed from sheets and tank components with forced air at ambient temperature.

B. Surface Preparation
1. Sheets and tank components shall be blasted using steel shot S-230.
2. Sheets and tank components shall be blasted on both sides providing a surface profile of SSPCSP10. Anchor profile shall be 1.0 mil minimum.

C. Powder Coating System
1. After cleaning and blasting, the sheets and tank components shall receive a Fusion Bond powder coating on both sides of steel. The powder coating shall be applied with an electrostatic process. The thermoset powder coat system shall be as specified:

LIQUID STORAGE	FUSION SYSTEM	DFT*	Range (min/max)
Interior Lining	LIQ Fusion 7000 FBE™	7 mils	6-9 mils
Exterior Primer	EXT Fusion 5000 FBE™	3 mils	3-5 mils
Exterior Topcoat	EXT Fusion SDP™	3 mils	3-5 mils

**DFT – Nominal dry film thickness*

2. Interior lining, LIQ Fusion 7000 FBE™ will be applied at 7 mils nominal DFT, with a min/max range from 6-9 mils.
3. Exterior prime coat, EXT Fusion 5000 FBE™ will be applied at 3 mils nominal DFT, with a min/max range from 3-5 mils.
4. Coating thickness shall be maintained by the use of PLC controlled automatic spray guns preset for the application.
5. Visual inspection for coverage shall be made after powder application and before the first oven cure. Areas with light coverage shall be re-sprayed with a manual spray gun.

D. Powder Curing
1. Sheets and tank components shall then be heated in an oven to achieve a metal temperature of 375° and held for 15 minutes.
2. After oven curing, the sheets and tank components shall cool down to a metal temperature of 125° or less.

3. Both visual inspection and dry film test shall be randomly performed before the application of the top coat.

E. EXT Fusion SDP™ Top Coat (super durable polyester)
   1. SDP top coat shall be applied on all exterior surfaces at 3 mils nominal DFT, with a min/max range from 3-5 mils.
   2. The SDP top coat shall provide excellent gloss retention and UV resistance. Color to be selected from standard colors (chart) with special formulated and premium colors as available options.
   3. Visual and wet mil thickness testing shall be randomly performed before the second oven curing.

F. Final Curing
   1. Sheets and tank components shall then pass through the final cure oven where the oven temperature ranges from 300° to 475° based upon the metal thickness.

G. Inspection
   1. During final cool down, sheets shall be randomly inspected for cure, adhesion, coating thickness and holidays.
   2. Cure shall be confirmed using MEK rub.
   3. Adhesion shall be confirmed using 100 squares test.
   4. Coating thickness shall be confirmed using dry film thickness gage.
   5. Holiday testing shall be performed with tinker & razor wet sponge.

H. Packaging
   1. After cool down and inspection, the sheets and tank components shall be unloaded and packaged for shipment.
   2. Sidewall sheets shall be stacked on wooden skids with paper placed between each sheet to prevent any scuffing. Skids shall be loaded to 5,600 pound maximum weight. Each skid shall be wrapped in heavy mil, black poly reinforced plastic and then steel banded.
   3. Roof sheets and hopper or bottom sheets as well as other tank components shall be packaged to prevent damage and then wrapped and banded.
   4. Material to be marked or tagged with part number and order number for field assembly requirements. Touch-up paint with instructions for application by erection personnel.

2.06 TANK STRUCTURE

A. Fusion Bond Powder-Coated Steel Floor
   1. The floor is to be a Fusion Bond powder-coated bolted steel floor. Bolted steel panels shall be placed over a compacted gravel base contained by a concrete ringwall. A non-extruding and resilient bituminous type filler, meeting the requirements of ASTM D1751, should be placed between the tank floor and concrete ringwall.

2. A plastic encapsulated nut shall be used to cover the bolt threads exposed on the inside of the floor.
3. Tolerance on finished foundations shall be level within +/- 1/8" within any 30 ft of circumference under the shell. The levelness on the circumference shall not vary by more than +/- ¼" from an established plane.

B. Alternative Embedded Base Setting Ring and Concrete Floor
1. The floor design is of reinforced concrete with an embedded fusion coated carbon steel starter sheet per the manufacturer's design and in accordance with AWWA D103, Sec. 13.4, Type 6.
2. A leveling assembly shall be used to secure the starter ring, prior to placement in concrete. Installation of the starter ring on concrete blocks or bricks, using shims for adjustment is not permitted.
3. Embedded base setting rings shall be level +/- 1/16 in within 10 feet of length and concentric +/- ¼ in.
4. Place one elastomer water stop seal strip on the inside surface of the starter ring below concrete floor line. Install materials in accordance with tank manufacturer's instructions.

C. Sidewall Structure
1. Field erection of the Fusion Bond powder-coated, bolted steel tank shall be in strict accordance with the procedures outlined by the manufacturer, using factory trained erectors.
2. Particular care shall be taken in handling and bolting of the tank panels and members to avoid abrasion of the coating system.
3. An electrical leak test shall be performed during erection using a wet sponge low voltage leak detection device. All electrical leak points found on the inside surface shall be repaired in accordance with manufacturer's published touch up procedures.
4. The placement of sealant on each panel may be inspected prior to placement of adjacent panels. However, the Engineer's inspection shall not relieve the bidder from his responsibility for liquid tightness.
5. No backfill shall be placed against the tank sidewall without prior written approval and design review of the tank manufacturer. Any backfill shall be placed according to the strict instructions of the tank manufacturer.

D. Roof Structure
1. Fusion Bond powder-coated steel deck.
    a. Tank shall include a sectioned roof fabricated from Fusion Bond powder-coated, bolted steel panels, as produced by the tank manufacturer, and shall be assembled in a similar manner as the sidewall panels. The roof shall be clear-span and self-supporting or post supported. Both live and dead loads shall be carried by the tank walls and any center supports.

E. Alternative Clear-span Aluminum Dome

1. The roof shall be constructed of non-corrugated triangular aluminum panels. Panels are sealed and firmly clamped in an interlocking manner to a fully triangulated aluminum space truss system of wide flange extrusions, thus forming a dome structure.
2. The dome shall be clear span and designed to be self-supporting from the periphery structure with primary horizontal thrust contained by an integral tension ring. The dome dead weight shall not exceed 3 pounds per square foot of surface area.
3. The dome and tank shall be designed to act as an integral unit. The tank shall be designed to support an aluminum dome roof including all specified live loads.
4. Materials:
    a. Triangulated space truss: 6061-T6 or 6005A-T6 aluminum struts and gussets.
    b. Triangulated closure panels: .050"t 3003-H16 aluminum sheet.
    c. Tension ring: 6061-T6 or 6005A-T6 aluminum.
    d. Fasteners: 7075-T73 anodized aluminum or series 300 stainless steel.
    e. Sealants and gaskets: gunnable silicone and neoprene rubber.
    f. Dormers, doors, vents and hatches: 6061-T6, 5086-H34 or 3003-H16 aluminum.

2.07 APPURTENANCES

The contractor shall furnish and install the appurtenances as shown on the contract drawings and as specified below.

Unless otherwise noted, standard appurtenances shall be as follows:

1. Roof Hatch: The tank roof shall have a curbed, upward opening 24" square. The curb shall extend at least four inches above the tank. The hatch cover lip shall be hinged and provisions made for locking. The hatch cover lip should extend for a distance of two inches down on the outside of the curb with a rubber gasket to seal the gap between the lid and curb. The hatch shall be located near the outside tank ladder with railing. The hatch material shall be type 316 stainless steel or similar material as the water tank, whichever is more resistant to corrosion.
2. Inlet, Outlet, Overflow, Drain and Overflow Connections: Inlet, outlet, drain and overflow connections shall conform to the sizes and locations specified on the plan sheets.
3. Roof Vent: A properly sized vent assembly in accordance with AWWA D103 shall be furnished and installed above the maximum water level of sufficient capacity so that at maximum design rate of water fill or withdrawal, the resulting interior design pressure / vacuum will not exceed the tank's rated design pressure / vacuum.. The vent shall be so designed in construction as to prevent the entrance of birds and/or animals by including a 4 mesh (1/4" opening size) galvanize screen, plus a 16 mesh (1/16" opening size) screen to prevent the entrance of insects. The overflow pipe shall not be considered to be a tank

vent. The vent shall be stainless steel (type 316) and so designed and constructed as to prevent the entrance of birds, animals, and any possible contaminate to the potable water.

4. Outside Tank Ladder: An outside ladder with safety cage shall begin 6 feet above the level of tank bottom and at the location designated. Outside ladder and cage shall meet OSHA requirements. The ladder and the cage material shall be made of type 316 stainless steel or similar material as the water tank, whichever is more resistant to corrosion.
5. Interior Tank Ladder: An interior ladder with safety cage shall be installed below the roof hatch. The ladder material shall be made of type 316 stainless steel or similar material as the water tank, whichever is more resistant to corrosion.
6. Handrail and Toeboard: Handrail and toeboard around the deck perimeter shall be installed as specified on the plan sheets. These shall be made of type 316 stainless steel or similar material as the water tank, whichever is more resistant to corrosion.
7. Roof Walkway Handrail: For tanks with a bolted stainless steel roof, a non-skid roof walkway with handrails shall be provided to allow ready and safe access to the gravity vent. The walkway and handrails shall be type 316 stainless steel and meet OSHA requirements. For tanks with a dome roof, non-skid walkway and handrails are incorporated by the dome supplier.
8. Liquid Level Indicator: A liquid level indicator with stainless steel (type 316) float and target board shall be installed as detailed on the plans and to the tank manufacturer's specifications.
9. Internal Nozzle with Overflow Weir Cone: The internal nozzle with overflow weir shall conform to the size and location specified on the plan sheets.
10. Manway: Two 24" diameter manway shall be provided at a location to be determined by the Engineer. The manway shall include a reinforcing frame and cover plate with a hinged support for cover removal. The manway material shall be type 316 stainless steel or similar material as the water tank, whichever is more resistant to corrosion. The access door (shell manhole) and the tank shell reinforcing shall comply with AWWA D103.
11. Thrust Blocks: Concrete thrust block is required on the buried elbows, tees, and gate valves. The piping assembly shall be tested in accordance with ASPA's Acceptance Tests for Pressure Piping.
12. Flap Gate Valve: A flap gate valve shall be attached to the end of the drain pipe in the catch basin. A 16 mesh screen shall be installed inside the flap gate to prevent insects from entering the pipe and tank. The flap gate shall be a hinged gate with a neoprene seal to provide a positive seal.
13. Identification Name Plate: The Manufacturer's nameplate shall list the tank diameter, height, capacity, installation date, storage use and model/serial number. The nameplate shall be affixed to the tank exterior sidewall location approximately five (5) feet from grade elevation.

The appurtenances shall be installed as shown on the Engineers drawings and as detailed in these specifications.

2.08 ACCESSORIES

1. Water Flow Meter: The flow meters shall be propeller turbine type furnished with fabricated carbon steel body, injection molded thermoplastic propeller and 12 to 15 mil NSF approved fusion bonded epoxy faced and drilled Class 150 ANSI or JIS flanged ends and shall be designed for 150 psi working pressure. Flow meter size shall be of the same size as indicated in the drawings. The meter body shall have the same nominal inside diameter throughout its length and shall be furnished with non-toxic liners. The meter accuracy shall register within plus or minus 1.5% or better of actual flow at normal flows and plus or minus 1.5% or better of low flow and shall have 6 digits totalizer. Registration shall be in 1,000s gallons. Sweep hand shall revolve once per 1,000 gallons. Meter shall be Sensus T2 or approved equal and conform to AWWA C701.
2. Altitude Valves: Altitude valves shall be of the hydraulically operated, pilot controlled, single seated, diaphragm type, globe valves (with resilient disc) and shall control the high water level in tanks and reservoirs without the need for floats or other devices. It shall be a non-throttling type valve and remain fully open until the "shut-off" point in the tank or reservoir is reached. The valve shall be designed as a two-way or one-way as shown in the drawings. The valve shall be manufactured by Cla-Val Co. or approved equal.

2.09 SHIPPING

All plates, supports, members and miscellaneous parts shall be packaged for shipment in such manner to prevent abrasion or scratching of the finished coating.

PART 3 – EXECUTION

3.01 FOUNDATION

A. The tank foundation is a part of this contract. The tank foundation shall be designed by the manufacturer to safely sustain the structure and its live loads. The design must be signed by a certified United States registered Professional Structural Engineer.
B. Tank footing design shall be based on requirements of the Geotechnical Investigation. The Geotechnical Investigation is either provided by the Owner or is included in this cost for the Contractor to provide. This is clarified in the bid documents.
C. The tank foundation shall be designed by the Manufacturer based on the soil bearing capacity as tested.

3.02 ERECTION

A. Field erection of the bolted steel tank will be in strict accordance with manufacturer's procedures using factory trained and certified erectors.
B. Particular care will be taken to protect the baked-on powder coated panels from damage (i.e., scratches, abrasion) during field installation.

C. Tank to be constructed utilizing synchronized (hydraulic screw) jacking process, which keeps construction crews at grade level for safety and point access quality control.
D. Any coating damage will be repaired per manufacturer's recommendations.
E. No backfill shall be placed against the tank sidewall during or after the construction process.

3.03 TESTING

A. Following completion of erection and cleaning of the tank, the tank shall be tested for liquid-tightness by filling the tank to its overflow elevation.
B. Any leaks disclosed by this tank test shall be corrected by the contractor in accordance with the tank manufacturer's recommendation.
C. Water required for testing will be provided by the Owner. The contractor shall be responsible in conveying the water to the tank for testing.

3.04 DISINFFECTION

A. The tank shall be disinfected in accordance with Section 00500.
B. The tank structure shall be disinfected at the time of testing in accordance with AWWA Standard C652-02 "Disinfection of Water Storage Facilities" using chlorination method number two. Disinfection shall be performed by a competent water treatment contractor.
C. Disinfection shall not take place until tank sealant is fully cured.

3.05 GRAVEL COVER

A. The area within 10-ft around the tank perimeter shall be covered with a uniform 2-inch layer of 1 inch minus washed gravel.

3.06 SITE GRADIG AND CLEANUP

A. Upon completion of the tank, the Contractor shall clean the site of all rubbish and grade the earth to provide effective drainage away from the base of the tank. The slope shall be 5% extending from the base in all directions a distance of 10 feet away from the tank.

3.07 QUALIFICATIONS FOR TANK MANUFACTURERS AND TANK ERECTORS (Require information to be submitted with Contractor's bid):

A. Tank Manufacturer: Company specializing in the fabrication of bolted steel water tanks. All uncoiling, punching, radius rolling and glass-furnace operations shall be at one location. The manufacturer shall have fabricated and supplied, at least, ten (10) bolted steel tanks of comparable or larger capacity in the past 12 months. Provide a list of current year tanks shipped, with the owner's name, contact persons and phone numbers. This information shall be provided with bid.

B. Tank Erector: Company specializing in performing erection of welded steel tanks shall have successfully erected a minimum of ten (10) comparable diameter or larger bolted steel tanks presently in full operational service in the United States. Provide a list complying tanks, owners' name, contact person and phone numbers. This information

shall be provided with bid.

C. Installation Crew: Installation of the tank shall be under the direction of the tank erector's factory certified tank builder and shall maintain the same foreman and crew from start to finish of work unless change is approved by Manager. Provide the names of the factory certified tank builders for each of the 10 tanks listed above. This information shall be provided with bid.

3.08 WARRANTY

A. The tank manufacturer shall include a warranty on tank materials and workmanship for a specified period. The tank manufacturer shall warrant the tank against any defects in materials for a period of ten (10) years from date of shipment and the contractor shall warrant the tank system against any defects in workmanship for a period of ten (10) years from the date of final acceptance. If any such defect shall appear and is reported in writing to the Contractor during the warranty period, the Contractor shall make any necessary repairs without charge to the Owner.

END OF SECTION

SECTION 00420

POTABLE WATER STORAGE TANK – BOLTED STAINLESS STEEL

PART 1 – GENERAL

1.01 SCOPE OF WORK

The work to be performed under these specifications includes furnishing all labor, materials, tools and equipment necessary to design, fabricate, and construct a new 320,000 gallon bolted stainless steel water storage tank, including all necessary accessories in accordance with AWWA D100 specifications, latest revision.

1.02 REFERENCE SPECIFICATIONS

The following reference specifications shall govern the work with regard to design materials and workmanship, where applicable.

ASTM A36 - Standard specification for structural steel.

ASTM A307 - Specification for carbon steel bolts.

ASTM A325 - Specification for high strength bolts for structural steel joints.

ASTM A240 - Specification for chromium-nickel stainless steel plate and sheet.

ASTM F593-98 - Standard specification for stainless steel bolts.

ASTM F594-98 - Standard specification for stainless steel nuts.

AISC - 89 - Specification for structural steel buildings.

And if required:

ANSI/AWWA D103 – 87 Factory coated bolted steel tanks for water storage.

ANSI/AWWA D103 – 97 Section 3, General design.

ANSI/AWWA C652 – 86 Disinfection of water storage facilities.

ANSI/AWWA D103 – 97 Section 5, Appurtenances as adapted for stainless steel.

ANSI/AWWA D103 – 97 Section 13, structurally supported aluminum dome.

ANSI/NSF STANDARD 61 - Drinking water system components.

1.03 SUBMITTAL DRAWINGS AND CALCULATIONS

Construction shall be governed by the Owner's plans and specifications showing general dimensions and construction details, after approval by the Engineer of submittal drawings and design calculations prepared by the manufacturer.

There shall be no deviation from these drawings and specifications, except upon written order or approval from the Engineer. The bidder is required to furnish, for review and approval by the Engineer, construction drawings for all work not shown in complete detail on the bidding drawings. A complete set of structural calculations shall be provided for the tank structure and foundation. All such submissions shall be stamped by a Registered Professional Engineer.

When approved, two sets of such prints and submittal information will be returned to the bidder marked "APPROVED FOR CONSTRUCTION" and these drawings will then govern for the work detailed thereon.

PART 2 – DESIGN

2.01 TANK SIZE LOADS

Job Site Location:	Upper Amouli area (see Dwg.ID: G1)
Product to be stored:	Drinking water
Specific Gravity:	1
PH of Product:	6.8~7.5
Temperature of Product:	23~35˚C
Nominal Capacity (Gallons):	320,000
Nominal Diameter (Feet):	48
Nominal Height (Feet):	28.6
Tank Base Elevation (Feet):	272.62
Min. Freeboard Space (Feet):	4.4
Design Pressure:	Atmospheric
Deck Live Load:	25 psf
Wind Speed:	200 mph
Seismic Zone:	3

2.02 DESIGN STANDARDS

The design of the bolted tank shall conform to AWWA D100, latest revision.

PART 3 – MATERIAL

3.01 PLATES AND SHEETS

Plates and sheets used in the construction of the tank shall be Type 316 stainless steel.

3.02 ROLLED STRUCTURAL SHAPES

Rolled structural shapes shall be type 316 stainless steel. Material shall conform to minimum standards of ASTM A36.

3.03 HORIZONTAL WIND STIFFENERS

Wind stiffener at top of tank shall provide a flat, horizontal, continuous surface at tank rim level, compatible with geodesic dome or roof mounting and flashing. Design requirements for intermediate horizontal wind stiffeners shall be of the "web truss" design. Wind stiffeners shall be type 316 stainless steel. Material shall conform to minimum standards of ASTM A36.

3.04 BOLT FASTENERS

Bolts used in tank lap joints shall be type 316 stainless steel 1/2 - 13 UNC-2A rolled thread.
Lap joint bolts shall be installed such that the head portion is located inside the tank and the washer and nut are on the exterior. Lap joint bolts shall be properly selected such that threaded portions will not be exposed in the "shear plane" between tank sheets. Bolt lengths shall be selected to achieve a neat and uniform appearance. Excessive threads extending beyond the nut after tightening is not acceptable.
Lap joint bolts shall include a minimum of four splines on the underside of the bolt head at the shank in order to resist rotation during tightening.

3.05 SEALANT

The lap joint sealant shall be a one component moisture cured polyurethane compound. The sealant shall be used to seal lap joints and bolt connections and to isolate dissimilar metals.
The sealant shall cure to a rubber-like consistency and have excellent adhesion, have low shrinkage, and be suitable for interior and exterior exposure.
Neoprene gaskets and tape type sealer shall not be used.
The sealant shall be NSF certified.

PART 4 – APPURTENANCES

The contractor shall furnish and install the appurtenances as shown on the contract drawings and as specified below.
Unless otherwise noted, standard appurtenances shall be as follows:

1. Hatch: The tank roof shall have a curbed, upward opening 24” square. The curb shall extend at least four inches above the tank. The hatch cover lip shall be hinged and provisions made for locking. The hatch cover lip should extend for a distance of two inches down on the outside of the curb with a rubber gasket to seal the gap between the lid and

curb. The hatch shall be located near the outside tank ladder with railing. The hatch material shall be type 316 stainless steel or similar material as the water tank, whichever is more resistant to corrosion.

2. Inlet, Outlet, Overflow, Drain and Overflow Connections: Inlet, outlet, drain and overflow connections shall conform to the sizes and locations specified on the plan sheets.
3. Vent: A mushroom-screened vent shall be furnished above maximum water level of sufficient size to accommodate normal inlet and outlet flow. The vent shall be so designed in construction as to prevent the entrance of birds and/or animals by including a 4 mesh (1/4" opening size) galvanize screen, plus a 16 mesh (1/16" opening size) screen to prevent the entrance of insects. The overflow pipe shall not be considered to be a tank vent. The vent shall be stainless steel (type 316) and so designed and constructed as to prevent the entrance of birds, animals, and any possible contaminate to the potable water.
4. Outside Tank Ladder: An outside ladder with safety cage shall begin 6 feet above the level of tank bottom and at the location designated. Outside ladder and cage shall meet OSHA requirements. The ladder and the cage material shall be made of type 316 stainless steel or similar material as the water tank, whichever is more resistant to corrosion.
5. Interior Tank Ladder: An interior ladder with safety cage shall be installed below the roof hatch. The ladder material shall be made of type 316 stainless steel or similar material as the water tank, whichever is more resistant to corrosion.
6. Handrail and Toeboard: Handrail and toeboard around the deck perimeter shall be installed as specified on the plan sheets. These shall be made of type 316 stainless steel or similar material as the water tank, whichever is more resistant to corrosion.
7. Roof Walkway Handrail: For tanks with a bolted stainless steel roof, a non-skid roof walkway with handrails shall be provided to allow ready and safe access to the gravity vent. The walkway and handrails shall be type 316 stainless steel and meet OSHA requirements. For tanks with a dome roof, non-skid walkway and handrails are incorporated by the dome supplier.
8. Liquid Level Indicator: A liquid level indicator with stainless steel (type 316) float and target board shall be installed as detailed on the plans and to the tank manufacturer's specifications.
9. Internal Nozzle with Overflow Weir Cone: The internal nozzle with overflow weir shall conform to the size and location specified on the plan sheets.
10. Manway: Two 24" diameter manway shall be provided at a location to be determined by the Engineer. The manway shall include a reinforcing frame and cover plate with a hinged support for cover removal. The manway material shall be type 316 stainless steel or similar material as the water tank, whichever is more resistant to corrosion.
11. Thrust Blocks: Concrete thrust block is required on the buried elbows, tees, and gate valves. The piping assembly shall be tested in accordance with ASPA's Acceptance Tests for Pressure Piping.

12. Flap Gate Valve: A flap gate valve shall be attached to the end of the drain pipe in the catch basin. A 16 mesh screen shall be installed inside the flap gate to prevent insects from entering the pipe and tank. The flap gate shall be a hinged gate with a neoprene seal to provide a positive seal.
13. Identification Name Plate: The Manufacturer's nameplate shall list the tank diameter, height, capacity, installation date, storage use and model/serial number. The nameplate shall be affixed to the tank exterior sidewall location approximately five (5) feet from grade elevation.
14. PVC Liner: The tank shall be lined with a heavy duty PVC liner of thickness 0.51 mm or more with suitable protection layer. The PVC liner shall be manufactured for the purposes of lining potable water tanks and the manufacturer of the PVC shall guarantee its suitability for this purpose and that it meets all standards.

The appurtenances shall be installed as shown on the Engineers drawings and as detailed in these specifications.

PART 5 – BOLTED FLOOR – (OPTIONAL)

A bolted stainless steel floor is allowed as an option to the reinforced concrete floor.

5.01 CONSTRUCTION

The bolted floor construction would include sectional bolted stainless steel floor panels as produced by the tank manufacturer. The floor shall be erected similar to the sidewall panels using the same sealant and bolting techniques. The bolted floor shall be supported by compacted sand or placed upon a concrete sub-floor. If a concrete sub-floor is utilized, a 1 inch thick layer of fiber cane shall be placed on the concrete floor prior to placement of the bolted steel floor.

PART 6 – BOLTED ROOF

A bolted stainless steel roof is allowed for tank diameters up to 36ft.

6.1 CONSTRUCTION

The roof shall be constructed of radial sections of bolted stainless steel roof panels as produced by the tank manufacturer with a knuckle formed down that bolts to the upper shell ring.
The roof panels shall be erected similar to the sidewall panels using the same sealant and bolting techniques. The roof shall be self-supporting and shall clear the span of the tank. The roof shall transfer the live and dead loads to the sidewall.

PART 7 – ALUMINIUM DOMED ROOF

Tanks greater than 36 foot diameter shall be supplied with aluminum dome roofs or other more corrosion resistant material as approved by Owners engineer.

7.1 CONSTRUCTION

The dome shall be constructed of non-corrugated triangular aluminum panels on a fully triangulated aluminum space truss system of wide flange extrusions, thus forming a spherical dome structure. The dome shall be clear span and designed to be self-supporting from the periphery structure with primary horizontal thrust contained by an integral tension ring. The dome dead weight shall not exceed 3 pounds per square foot of surface area. The dome and tank shall be designed to act as an integral unit. The tank shall be designed to support an aluminum dome roof including all specified loads.

PART 8 – ERECTION

8.01 FOUNDATION

The tank foundation is a part of this contract. The tank foundation shall be designed by the manufacturer to safely sustain the structure and its live loads.
Tank footing design shall be based on requirements of the Geotechnical Investigation. The Geotechnical Investigation is either provided by the Owner or is included in this cost for the Contractor to provide. This is clarified in the bid documents.
The tank foundation shall be designed by the Manufacturer based on the soil bearing capacity as tested. Existing foundation may be used if suitable to meet the new design requirements. Contractor is responsible for determining the suitability of the existing foundation.

8.02 CONCRETE FLOOR

The standard floor design is of reinforced concrete with an embedded stainless steel starter ring.

8.03 STARTER RING

The starter ring shall be leveled and rounded prior to encasement in concrete. A leveling plate assembly shall be used to secure the starter ring.
Prior to placement of concrete, butyl rubber and bentonite water stop seals shall be placed on the inside surface of the starter ring below the concrete floor line. These materials shall be installed as shown on the construction drawings.

8.04 LAPPED JOINTS

All vertical, horizontal, shell to roof, and shell to bottom plates or sheets shall be field bolted. Sealant shall be used on all joints to ensure liquid tightness. Fillet sealant at all lapped joints to provide a neat and pleasing appearance.

8.05 SIDEWALL

Placing of sealant on each connection may be inspected by the Engineer prior to placement of adjacent member. However, the Engineer's inspection shall not relieve the erector of his responsibility for liquid tightness.

8.06 PVC LINER

The PVC liner shall be placed and fasten to tank sides in accordance to manufacturer recommendations and an insulation layer shall be placed between liner and steel tank as recommended by manufacturer. The liner should extend over the sides of the tank for about 25 cm on the outside.

8.07 QUALIFICATIONS FOR TANK MANUFACTURERS AND TANK ERECTORS (Require information to be submitted with Contractor's bid):

Tank Manufacturer: Company specializing in the fabrication of bolted stainless steel water tanks. All uncoiling, punching, radius rolling and furnace operations shall be at one location. The manufacturer shall have fabricated and supplied, at least, ten (10) bolted steel tanks of comparable or larger capacity in the past 24 months. Provide a list of current year tanks shipped, with the owner's name, contact persons and phone numbers. This information shall be provided with bid.

Tank Erector: Company specializing in performing erection of welded steel tanks shall have successfully erected a minimum of ten (10) comparable diameter or larger bolted steel tanks presently in full operational service in the United States. Provide a list complying tanks, owners' name, contact person and phone numbers. This information shall be provided with bid.

Installation Crew: Installation of the tank shall be under the direction of the tank erector's factory certified tank builder and shall maintain the same foreman and crew from start to finish of work unless change is approved by Manager. Provide the names of the factory certified tank builders for each of the 10 tanks listed above. This information shall be provided with bid.

PART 9 – LEAK TEST

Leak test shall not take place until joint sealant is fully cured (10 to 12 days at 73 degrees F).

9.01 HYDROTEST

The tank shall be hydro tested to ensure liquid tightness by filling the tank to its overflow elevation. Water and disposal of as required for this test shall be the responsibility of the Contractor.

PART 10 – ACCESSORIES

10.01 WATER FLOW METER

The flow meters shall be propeller turbine type furnished with fabricated carbon steel body, injection molded thermoplastic propeller and 12 to 15 mil NSF approved fusion bonded epoxy faced and drilled Class 150 ANSI or JIS flanged ends and shall be designed for 150 psi working pressure. Flow meter size shall be of the same size as indicated in the drawings. The meter body shall have the same nominal inside diameter throughout its length and shall be furnished with non-toxic liners. The meter accuracy shall register within plus or minus 1.5% or better of actual flow at normal flows and plus or minus 1.5% or better of low flow and shall have 6 digits totalizer. Registration shall be in 1,000s gallons. Sweep hand shall revolve once per 1,000 gallons. Meter shall be Sensus T2 or approved equal and conform to AWWA C701.

10.02 ALTITUDE VALVES

Altitude valves shall be of the hydraulically operated, pilot controlled, single seated, diaphragm type, globe valves (with resilient disc) and shall control the high water level in tanks and reservoirs without the need for floats or other devices. It shall be a non-throttling type valve and remain fully open until the "shut-off" point in the tank or reservoir is reached. The valve shall be designed as a two-way or one-way as shown in the drawings. The valve shall be manufactured by Cla-Val Co. or approved equal.

PART 11 – WARRANTY

11.01 STRUCTURES

If within a period of ten (10) years from date of completion the water storage tank, or any part thereof, proves to be defective in material or workmanship upon examination by Manufacturer, the Manufacturer will supply replacement part to ASPA's Tafuna Campus, at its option will repair or allow credit for such part.

Manufacturer shall further warrant that, if within a period of ten (10) years from the date of completion of the stainless steel sheets placed in the storage tank fail due to corrosion as determined upon examination by the manufacturer or Owners representative, the manufacturer will supply replacement sheets to ASPA's Tafuna Campus, at its option will repair or allow credit for such sheets.

END OF SECTION

SECTION 00430

POTABLE WATER STORAGE TANK – CONVENTIONAL REINFORCED CONCRETE TANK WITH ANCHORED FLEXIBLE BASE

PART 1 – GENERAL

1.01 DESCRIPTION

A. Work Included

1. This section specifies the design qualifications for the Tank Contractor and Designer and requirements for the tank design and construction materials used in the tank.

2. In the event of discrepancy between this section of the Specifications and any other section of the Specifications, this section shall govern.

3. The tank shall conform to the dimensions and be equipped with the appurtenances shown on the Drawings and as specified herein.

4. The Tank Contractor shall furnish all labor, materials, tools, and equipment necessary to construct, disinfect and test the conventionally reinforced concrete tank and appurtenances as indicated on the drawings, and as specified.

B. Related Work Described Elsewhere

1. Rock Excavation

2. Piping

C. Description of System

The tank shall consist of a cast-in-place reinforced concrete floor and wall footing, a conventionally reinforced, cast-in-place concrete wall, and column supported flat slab roof.

1.02 QUALITY ASSURANCE

A. Qualifications and Experience

1. Singular Responsibility: It is the intent of this specification to require single party responsibility for the design and construction of the cast-in-place conventionally reinforced concrete tank. The tank design and construction shall be performed by an established Tank Contractor of recognized ability, having at least ten years of experience in the design and construction of conventionally reinforced concrete tanks as specified herein. The design and construction of all aspects of the foundation, floor slab, wall, and roof of the conventionally reinforced concrete tank shall be performed by the Tank Contractor. The Tank Contractor may subcontract labor for reinforcing steel installation and for concrete slab placement under the Tank

Contractor's direct supervision.

2. All tank work shall be performed by a company that specializes in the design and construction of cast-in-place, conventionally reinforced concrete tanks and with proven capability of meeting all the requirements of these specifications. No company is considered qualified unless it has designed and built in its own name at least five cast-in-place, conventionally reinforced concrete tanks in the last ten years. The company shall have in its own name or under one of its divisions, at least five conventionally reinforced concrete tanks that are located in an area with an S_{DS} of 0.75g or higher and have been in successful service for at least five years.

3. The Tank Contractor shall have in its employ a design professional engineer with a minimum experience of ten years in the design of conventionally reinforced concrete tanks. The design engineer shall have been the engineer of record for a minimum of five conventionally reinforced concrete tanks in the past ten years. The design engineer shall have designed a minimum of five conventionally reinforced concrete tanks located in an area with an S_{DS} of 0.75g or higher in the past five years.

4. Experience in the design and construction of AWWA D110 tanks, conventionally reinforced tanks having fixed wall bases, tank core walls incorporating internal stressing systems is not acceptable.

B. Codes & Standards

All Codes shall be considered the most current version of that code unless noted otherwise.

1. ACI 301 Specifications for Structural Concrete

2. ACI 305 Hot Weather Concreting

3. ACI 306 Cold Weather Concreting

4. ACI 309R Guide for Consolidation of Concrete

5. ACI 318 Building Code Requirements for Reinforced Concrete and Commentary

6. ACI 350 Code Requirements for Environmental Engineering Concrete Structures and Commentary

7. ACI 350.1 Tightness Testing of Environmental Engineering Concrete Structures and Commentary

8. ACI 350.3 Seismic Design of Liquid Containing Concrete Structures and Commentary

9. ASTM A123/A123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

10. ASTM A185 Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete

11. ASTM A475 Standard Specification for Zinc-Coated Steel Wire Strand

12. ASTM A615/A615M Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

13. ASTM A706/A706M Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement

14. ASTM C31 Standard Practice for Making and Curing Concrete Test Specimens in the Field

15. ASTM C33 Standard Specification for Concrete Aggregates

16. ASTM C39 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

17. ASTM C231 Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

18. ASTM C618, Type F Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

19. ASTM C920 Specification for Elastomeric Joint Sealants

20. ASTM D1056 Standard Specification for Flexible Cellular Materials – Sponge or Expanded Rubber

21. ASTM D1556 Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method

22. ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 Ft. – lbf/ft^3) 2700 KN-M/M^3)

23. ASTM D2000 Classification System for Rubber Products in Automotive Applications

24. ASCE Standard 7 Minimum Design Loads for Buildings and Other Structures

25. AWWA C652 Standard for Disinfection of Water-Storage Facilities

26. US Army Corps of Engineers Specification CRD-C-572, Specification for PVC Waterstop

C. Design Criteria

1. The conventionally reinforced concrete tank shall be designed and constructed in accordance with the provisions of ACI 350, ACI 350.3, ASCE 7 and IBC.

2. The Tank Contractor shall use the following loadings and requirements in the design calculation:

a. Capacity: 320,000 gallons.

b. Dimensions: 48 ft. outside diameter, 28.6 ft. height.

c. Foundation Loads: the tank foundation shall be proportioned so that soil pressure shall be less than the soil bearing capacity. Bearing capacity is provided in the geotechnical report

d. Seismic Criteria:

i. Seismic Design Criteria: Seismic design shall be based on the applicable sections of ACI 350.3, ASCE 7 and the local jurisdictional building code. The comparative value of 80% as specified in ASCE 7, Section 15.4.1, paragraph 6 shall be used to determine the total base shear from ASCE 7. 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.

ii. Sloshing Height: The sloshing height shall be determined using the maximum value calculated for the fluid displacement based on ACI 350.3 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. A minimum freeboard height of 12 inches, unless shown otherwise on the drawings, above the design liquid level shall be utilized. Any confined portion of the convective (sloshing) mass shall be calculated and applied as an additional impulsive mass.

iii. Base Restraint Cable Design:

1. The base restraint cables shall be designed for the total base shear obtained from the maximum values of impulsive and convective components and the dynamic effects of backfill. The allowable cable stress is 0.75 fpu.

2. For the total base shear obtained from the loading conditions of ASCE 7 that incorporate an over strength factor (Omega Factor), the allowable cable stress shall be increased by 20%. The Omega factor shall be 2.0 for all loading cases.

e. Wind Loads: 200 mph

f. Vent Capacity Requirements:

i. Maximum Fill Rate: 320 gpm.

ii. Maximum Draw Down Rate: 200 gpm.

g. Overflow Design Capacity: 320 gpm.

3. The Tank Contractor shall design the tank cast-in-place wall based on the following design criteria and requirements:

a. Minimum total wall thickness at any height shall be 12 inches.

b. The minimal "final" circumferential force to contain the waterload at the bottom of the wall shall be:

Pcw = 62.5 (R) (H) (lbs/ft of height).

Where, R = inside radius of wall (feet).

H = maximum overload water height (feet).

This force shall taper uniformly to zero at the top of the maximum overload water height. The maximum allowable stress in the reinforcing to counteract the water load shall be 20,000 psi. No contribution from the wall concrete or backfill shall be used to counteract the internal water load.

c. The minimum circumferential mild-steel reinforcing for differential temperature and dryness bending shall be no less than 0.30 percent of the cross-sectional area of the tank corewall. This steel shall be additive to the steel required for the water load above. The minimum combined circumferential steel reinforcing at any location shall be no less than 0.50 percent of the cross-sectional area of the tank corewall. The minimum vertical steel reinforcing at any location shall be 0.50 percent of the cross-sectional area of the tank corewall. The maximum spacing of vertical and circumferential reinforcing shall be 12 inches. Both the circumferential and vertical steel shall be placed equally on both faces of the tank corewall.

d. The cast-in-place tank corewall shall be supported by solid neoprene bearing pads allowing free radial movement of the wall relative to the wall footing. The walls shall be tied circumferentially to the wall footing with seismic cables consisting of hot-dip galvanized strands encased in closed cell sponge rubber sleeves. A PVC waterstop connection shall be provided between wall and wall footing.

e. The minimum pad thickness and width under the cast-in-place tank corewall shall be 0.5 inch and 5 inches, respectively.

f. All neoprene or natural rubber pad sections shall be based on continuous loading values not to exceed those allowed in the neoprene design manual.

g. No reduction in ring compression or tension in the cast-in-place tank corewall will be taken due to restraint at the bottom.

h. Friction between wall and rubber bearing pads and lateral soil pressures shall not be considered in resisting seismically generated shear forces between the wall footing and the wall between. These forces shall be resisted by positive connections taking the loads in the tangential direction only and at the same time allowing free radial motion of the wall.

i. Walls which are precasted, shotcreted or walls which incorporate internal stressing systems shall not be considered.

4. The Tank Contractor shall design the wall footing based on the following design criteria and requirements:

a. The circumferential wall footing reinforcing, for differential dryness purposes, shall have a minimum total cross-sectional area no less than 0.5% of the wall footing section excluding any reinforcement requirements for bursting forces due to waterloads.

b. Bursting forces caused by liquids acting on wall footings shall be taken up fully by reinforcing steel in the radial or circumferential direction at steel stresses not exceeding 20,000 psi. No credit shall be given to radial slide resistance effects of soils on footings.

c. Hinged or fixed wall to wall footing connections shall not be considered.

d. Radial and circumferential bar sizes shall not exceed 3/4 inch.

e. Splices in parallel bars shall be adequately staggered to avoid more than one splice at any point around the circumference of the wall footing.

f. The minimum width of the wall footing shall be 4.0 feet and the minimum thickness shall be 1.25 foot.

5. The Tank Contractor shall design the tank floor based on the following design criteria and requirements:

a. The floor thickness shall be no less than 6 inches nominal with a plus or minus construction tolerance of 1/2 inch.

b. The floor reinforcing in each direction shall be no less than 0.5% of the nominal floor section with a maximum bar spacing of 12 inches. Floor thicknesses in excess of 8 inches shall have 2 layers of steel with the bottom mat at least 2 inches off the ground.

c. Post-tensioning of floors shall not be considered.

d. Tanks utilizing footings having any projections extending below the elevation of the bottom of the slab, which could in any way restrain slab shrinkage, must include floors having radial joints crossing the

center of the tank at 90^{o} or their equivalent unless the floor reinforcing in each direction is no less than 1/2 percent of the nominal floor section.

6. Flat Slab Roof

a. The roof shall be cast-in-place, flat-slab reinforced concrete with a minimum thickness of 9 inches.

b. The concrete cover over regular reinforcing steel in flat roof slabs shall be 2.0 inch nominal with a plus or minus 1/4" construction tolerance.

c. The interior columns shall have a minimum diameter of 18 inches.

d. Column shall be reinforced with vertical and spiral reinforcement

e. The roof shall be supported by solid neoprene or natural rubber bearing pads, according to the specifications herein, allowing free radial movement of the wall and roof. The roof shall be tied circumferentially with seismic connections to the tank wall, designed by the Tank Contractor which permits free radial movement of wall and roof.

i. All neoprene or natural rubber pad sections shall be based on continuous loading values not to exceed those allowed in the neoprene design manual.

ii. The minimum bearing pad thickness and width under roof slab shall be 0.5 inch and 2 inches, respectively.

iii. The remaining voids between wall and roof, not taken up by the solid neoprene or natural rubber pads, shall be filled with closed cell rubber pads and soft mastic to ensure a substantially unrestrained free movement of wall and roof.

f. Non-prestressed steel-reinforced concrete flat slabs shall conform to the applicable requirements of ACI 350, including sanitary environmental durability coefficients factor with special attention to crack control.

g. The design shall provide a weather-tight roof to minimize cracking and to prevent leakage and contamination of the contents. Consideration shall be given for the exposure conditions. Reinforcement of concrete slabs shall also be provided to resist temperature stresses.

h. Alternate roof designs such as post-tensioned, pre-tensioned, precast or waffle type roofs shall not be considered.

1.03 SUBMITTALS

A. Submittals Required with the Bid Documents

1. Tank Contractors shall submit preliminary design drawings and calculations showing the dimensions of the tank, details of the type of construction, and sizes of principal members. The drawings and calculations shall be of sufficient detail to show compliance with the specification and all required standards and shall be signed and sealed by an Engineer registered in the state the tank is to be constructed.

2. Tank Contractors shall submit an experience record for the tanks they have designed and built in their own name meeting the requirements specified in paragraph 1.02-A-2. The record shall include the Tank Contractor's experience in the design and construction of conventionally reinforced concrete tanks. The record shall also indicate the size of the tank, the name and address of the Owner, the year of construction, and the name of the Engineer for each project.

3. Tank Contractors shall submit the name of the tank designer currently in its employ meeting the requirements of paragraph 1.02-A-3, and his/her experience as the designer of record for conventionally reinforced concrete tanks, including the size of the tank, seismic parameters, the name and address of the Owner, the year of construction and the name of the Engineer.

4. Tank Contractors shall submit the resumes for each member of the project team including the tank superintendent and project manager that will be used for this project.

5. 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. In addition, the Tank Contractor's bid will be rejected if submitted drawings and technical documents are not in conformance with the technical requirements of the project specifications.

B. Design Submittal after Execution of Contract

1. Design calculations and drawings in quadruplicate, showing details and procedures of construction, shall be submitted to the Engineer for approval after execution of the Contract. After approval by the Engineer, one set of the drawings and calculations will be returned to the Tank Contractor, and any changes found necessary by the Engineer shall be made by the Tank Contractor.

2. Approval by the Engineer of the drawings and calculations submitted by the Tank Contractor will not in any way relieve the Tank Contractor of full responsibility for the accuracy and completeness of the drawings and calculations.

3. Design calculations and drawings shall be stamped by a professional engineer experienced in the design of conventionally reinforced concrete tanks and registered in the state the tank is to be constructed.

C. Construction Submittals for Review Prior to Use

1. Design proportions for all concrete. Concrete strengths of trial mixes.

2. Admixtures to be used in the concrete and their purpose.

3. Reinforcing steel shop drawings showing fabrication and placement.

4. Catalog cuts or shop drawings of all appurtenances, i.e. hatch, vent, ladders, waterstops.

1.04 GUARANTEE

The Tank Contractor shall guarantee the structure against defective materials or workmanship for a period of ten years from the date of completion. If any materials or workmanship prove to be defective within ten year, they shall be replaced or repaired by the Tank Contractor at the Tank Contractor's expense.

PART 2 – MATERIAL

2.01 CONCRETE

A. Concrete shall conform to ACI 301.

B. Cement shall be Portland cement Type I or Type II.

C. Admixtures, other than air-entraining, superplasticizers, shrinkage reducing and water reducing will not be permitted unless approved by the Engineer.

D. Concrete for tank wall and roof construction shall have a minimum compressive strength of 4,000 psi at twenty-eight days and a maximum water to cement ratio of 0.42.

E. Concrete for the tank floor, footings, pipe encasement, and all other work shall have a minimum compressive strength of 4,000 psi at twenty-eight days, shall not be air-entrained and have a maximum water to cement ratio of 0.42. The coarse and fine aggregate shall meet the requirements of ASTM C33. Coarse aggregate shall be No. 467 with 100% passing the 1½ inch sieve. Superplasticizers, water-reducing, and shrinkage reducing (if applicable) admixtures shall be incorporated into the floor concrete. If fibers are used, they shall be virgin poly-propylene or cellulose fibers, Microfiber by Grace, Fibermesh 150 by Propex, UltraFiber 500 by Buckeye, or equal. Fiber lengths shall be a maximum of ¾ inches. The amount of fibers added to the concrete mix shall conform to the Manufacturer's recommendations.

F. Proportioning for concrete shall be in accordance with ACI 301.

G. All concrete shall have a maximum water soluble chloride ion concentration of 0.06% by weight of cement.

2.02 REINFORCING STEEL

A. Reinforcing steel shall be new billet steel Grade 60, as shown on the Drawings, meeting the requirements of ASTM A615. Welded wire fabric and weldable reinforcing steel shall conform to ASTM A185 and ASTM A706, respectively

B. Reinforcing steel shall be accurately fabricated and shall be free from loose rust, scale, and contaminants, which reduce bond.

C. Reinforcing steel shall be accurately positioned on supports, spacers, hangers, or other reinforcements and shall be secured in place with wire ties or suitable clips. Rebar chair supports may be either steel with plastic tips, turned up legs or plastic.

D. Circumferential reinforcing shall be continuous through vertical wall joints.

E. Continuous reinforcing is required through floor and roof joints, where applicable, shall have a Class A galvanized coating or epoxy coating.

2.03 BASE RESTRAINT CABLES

A. The tank designer shall use base restraint cables to resist earthquake loads. Base restraint cables shall be hot-dip galvanized seven-wire strand and shall be manufactured in accordance with ASTM A416 prior to galvanizing, and ASTM A475 after galvanizing. Only seven-wire strand will be allowed.

B. Hot-dip galvanized seven-wire strand shall have a nominal strand diameter of 0.375 in, 0.50 in or 0.60 in. 0.375 inch diameter strand shall have an MUS after galvanization of 21.36 kips and a min. yield at 1% extension of 15.60 ksi. 0.50 inch diameter strand shall have an MUS after galvanization of 38.25 kips and a min. yield at 1% extension of 28.00 ksi. 0.60 inch diameter strand shall have an MUS after galvanization of 54.20 kips and a min. yield at 1% extension of 40.70 ksi. All strands shall have a minimum of weight of Zinc Coating of 0.85 oz/sq-ft.

C. Neoprene sleeves for base restraint cables shall be closed-cell conforming to ASTM D1056, Type 2, Class A, and Grade 3. The sleeves shall have a compression deflection limited to 25% at 9 to 13 psi, hardness of 60 to 80 durometer, a minimum tensile strength of 175 psi, a minimum elongation of 180%, and a maximum compressive set of 35%.

2.04 ELASTOMERIC MATERIALS

A. A 9-inch minimum waterstop with centerbulb shall be polyvinyl chloride meeting the requirements of the Corps of Engineers Specification CRD-C 572. Splices shall be made in accordance with the Manufacturer's recommendations subject to the approval of the Engineer. Waterstop shall be manufactured by Greenstreak Plastic Products Company, Inc., or equal.

B. Bearing pads shall be natural rubber or neoprene.

1. Natural rubber bearing pads shall contain only virgin natural polyisoprene as the raw polymer and the physical properties shall comply with ASTM D2000 Line Call-Out M 4 AA 414 A1 3.

2. Neoprene bearing pads shall have a hardness of 40 to 50 durometer, a minimum tensile strength of 1,500 psi, a minimum elongation of 500%, and a maximum compressive set of 50%. Pads shall meet the requirements of ASTM D2000 Line Call-Out M 2 BC 410 A1 4 B14 or M 2 BC 414 A14 C12 F17 for 40 durometer material.

C. Sponge filler shall be closed-cell neoprene or rubber conforming to ASTM D1056, Type 2, Class A, and Grade 1 or 3. Compression deflection limited to 25% at 2 to 5 psi.

D. Polysulfide or polyurethane sealant will be a two or three component elastomeric compound meeting the requirements of ASTM C920. Sealants shall have permanent characteristics of bond to metal surfaces, flexibility, and resistance to extrusion due to hydrostatic pressure. Air cured sealants shall not be used.

E. The remaining voids below the wall, not taken up by the solid neoprene or natural rubber pads, shall be filled with closed cell rubber pads and soft mastic to ensure a substantially unrestrained free movement of wall and flat slab roof.

2.05 EXTERIOR COATINGS FOR EXPOSED SURFACES

A. If required decorative coating shall be applied to the above grade exterior wall surfaces using two coats of a non-cementitious, high build, 100% acrylic resin polymer such as “Tammscoat Smooth” textured protective coating or equal.

2.06 APPURTENANCES

A. The Contractor shall locate all utilities (including pipe alignment) on project site provide and install all appurtenances as shown on the drawings. Appurtenances shall include the following:

1. Inlet Piping, Pipe Brackets and Concrete Pipe Encasement as shown on plans / drawings as follows:

a. Pipe: 8 inch inlet pipe the Water Storage Tank.

b. Material: Ductile Iron Pipe and Fittings.

2. Outlet Piping and Concrete Pipe Encasement as shown on the plans / drawings as follows:

a. Pipe: 8 inch outlet pipe for Water Storage Tank, respectively.

b. Material: Ductile Iron Pipe and Fittings.

3. Drain Piping and Concrete Pipe Encasement as shown on the drawings / Plans as follows:

a. Pipe: 8 inch drain pipe.

b. Material: Ductile Iron Pipe and Fittings.

4. Overflow Piping and Pipe Brackets as shown on the Plans / Drawings as follows:

a. Pipe: 8 inch overflow pipe.

b. Material: Ductile Iron Pipe and Fittings.

5. Roof Hatch: A 4 feet x 8 feet rectangular aluminum hatch with lockable, hinged cover and curb frame. The hatch shall have a lift handle, padlock tab, padlock and a cover hold open mechanism. All hardware shall be stainless steel, unless otherwise noted on the drawings. Locate hatch as shown on drawings.

6. Roof Ventilator: Aluminum, with stainless steel insect 20 x 20 screen, minimum diameter 2 feet. Roof Ventilator shall be Greenheck GRS-24 or approve equal.

7. 24" square or round through wall MANWAY.

8. Exterior Ladder: The ladder shall extend from the floor to the hatch. The ladder shall be made out of Galvanized Steel and have an OSHA-approved Stainless Steel fall prevention device consisting of a sliding, locking mechanism and safety belt. The ladder shall also include a safety cage with anti-climb plate. Location as shown on the drawings.

9. Interior Ladder: The ladder shall extend from the floor to the hatch.

10. Handrail: The handrail shall be made out of Stainless Steel or similar material as the water tank, whichever is more resistant to corrosion. Location as shown on drawings.

2.06 ACCESSORIES

A. WATER FLOW METER

The flow meters shall be propeller turbine type furnished with fabricated carbon steel body, injection molded thermoplastic propeller and 12 to 15 mil NSF approved fusion bonded epoxy faced and drilled Class 150 ANSI or JIS flanged ends and shall be designed for 150 psi working pressure. Flow meter size shall be of the same size as indicated in the drawings. The meter body shall have the same nominal inside diameter throughout its length and shall be furnished with non-toxic liners. The meter accuracy shall register within plus or minus 1.5% or better of actual flow at normal flows and plus or minus 1.5% or better of low flow and shall have 6 digits totalizer. Registration shall be in 1,000s gallons. Sweep hand shall revolve once per 1,000 gallons. Meter shall be Sensus T2 or approved equal and conform to AWWA C701.

B. ALTITUDE VALVES

Altitude valves shall be of the hydraulically operated, pilot controlled, single

seated, diaphragm type, globe valves (with resilient disc) and shall control the high water level in tanks and reservoirs without the need for floats or other devices. It shall be a non-throttling type valve and remain fully open until the "shut-off" point in the tank or reservoir is reached. The valve shall be designed as a two-way or one-way as shown in the drawings. The valve shall be manufactured by Cla-Val Co. or approved equal.

PART 3 – CONSTRUCTION

3.01 SAFETY

C. Tank Contractor to conform and enforce all Local and Federal OSHA safety rules and regulations.

3.02 CLEARING, GRUBBING, AND STRIPPING

A. All trees, shrubs, brush, stumps, roots, and other unsuitable material shall be removed to a minimum distance of 12 feet outside the edge of the tank foundation, plus additional areas necessary for the tank construction. The limits of clearing shall be as shown on the drawings and/or as approved by the Engineer.

B. No burning will be allowed unless approved by the Engineer and local authorities. All trees and vegetation shall be disposed of off-site, unless approved otherwise by the Engineer.

C. All topsoil shall be stripped from the proposed construction work area and stockpiled on site.

3.03 EXCAVATION AND BACKFILL

A. The excavation shall be dewatered as required during construction. The dewatering method used shall prevent disturbance of the tank foundation soils.

B. In the event the subgrade material is disturbed or over excavated by the Contractor during excavation, it shall be removed and replaced with compacted select fill, at the Contractor's expense.

C. A minimum of 6 inches of leveling base material shall be placed on top of the engineered fill, as described in item 3.03 E.

D. In areas to be filled (bottom of the excavation), the exposed surface should be scarified to at least an 8-inch depth, moisture conditioned to at least optimum moisture content and compacted to at least 95 percent relative compacted based on ASTM D1557. The Engineer shall inspect the subgrade for conformance with the Geotechnical Investigation confirming its suitability for the tank foundation. Before

any select fill is to be placed against rock surfaces, the rock shall be relatively free of all vegetation, dirt, clay, boulders, scale, excessively cracked rock, loose fragments, ice, snow, and other objectionable substances. All free water left on the surface of the rock shall be removed.

E. A leveling base material consisting of a minimum 6 inch thick layer of compacted select fill shall be placed beneath the entire tank foundation. If required by the Tank Design, a non-woven geotextile fabric such as Mirafi 1100N, Propex 4545, or equal, shall be placed between the subgrade and leveling base material as shown on the drawings or directed by the tank builder. Select fill shall conform to the provisions of Section 26 (Caltrans) for ¾ inch maximum Class 2 Aggregate Base, and should be compacted to at least 95 percent relative compaction based on ASTM D1557.

F. The surface elevation of the leveling base shall be fine graded to a tolerance of plus zero inches to minus ½ inch over the entire foundation areas. Fine grading tolerances for floor pipe encasements shall be plus zero inches to minus 6 inches.

G. The tank shall be backfilled and rough graded to the contours shown on the drawings. The fill shall be placed in lift not exceeding 8 inches in loose thickness, moisture conditioned to at least optimum moisture content, and compacted to at least 95 percent relative compaction. Unless other material is specified by the Engineer, materials used for backfilling shall be suitable on site material.

H. Frozen material shall not be used for backfill nor shall fill material be placed on snow, ice, or frozen material. Rock or concrete spoils (greater than 6 inches) shall not be used in backfill within 2 feet of the tank wall.

3.04 FLOOR

A. The floor and wall footings shall be constructed to the dimensions shown on the Approved Shop Drawings.

B. Prior to placement of the floor reinforcing, a 6 mil polyethylene moisture barrier shall be placed over the leveling base material. Joints in the polyethylene shall be overlapped a minimum of 6 inches.

C. Prior to placement of the floor concrete, all piping that penetrates the floor shall be set and encased in concrete.

D. The vertical waterstop shall be placed and supported so that the bottom of the center bulb is at the elevation of the top of the footing. The waterstop shall be supported without puncturing any portion of the waterstop other than pre-manufactured holes, grommets or hog rings for tying at 12 inches o.c.. The waterstop shall be spliced using a thermostatically controlled sealing iron and each splice shall be successfully spark tested prior to encasement in concrete.

E. Floors over 20,000 sq. ft. in surface area, at the option of the Tank Contractor, may have one or more construction joints. Such construction joints shall be approved by

the Engineer prior to placement and shall include a continuous water stop and galvanized or epoxy coated reinforcement through joint.

F. The floor shall be cured by applying one coat of curing compound, curing blankets and/or flooding with water, and shall remain saturated for a minimum of seven days.

3.05 CAST-IN-PLACE COREWALL

A. The wall shall have a minimum thickness of 12 inches and be poured without any horizontal joints. The wall design shall be such that wall sections can be poured full height without creating horizontal cold joints.

B. The out of round tolerance is: 3/4 inch in 50 feet, 3/8 inch in 10 feet and 3/16 inch in 24 inches from the true curvature specified at any point on the wall.

C. The maximum permissible variation in the vertical alignment, from the bottom to the top of the wall, is plus or minus 3/8 inch.

D. The allowable tolerance in the average wall thickness for poured walls shall not vary more than 1/8 inch either way. All transitions from plus to minus shall be gradual, even and smooth, and without abrupt changes in the surfaces.

E. Removal of wall forms shall not be started any sooner than twelve hours of accumulated time with the ambient air temperature above 50°F after completion of the wall pour. Pour back of adjacent wall sections shall commence no sooner than thirty-six hours of accumulated time with the ambient air temperature above 50°F after completion of the preceding, adjacent wall pour.

F. The use of slipform construction on liquid-retaining walls will not be permitted on any part of the tank, unless the Contractor can satisfactorily demonstrate to the Engineer that there will not be any "tearing" of the corewall.

G. Concrete in the cast-in-place corewall may be deposited from the top of the wall form such that no separation of the coarse aggregate from the mortar takes place.

3.06 COLUMNS AND COLUMN FOOTINGS

A. The columns and column footings shall be constructed as shown on the approved shop drawings.

B. All column footings shall project above the floor and not below the floor. The size of these footings shall be determined based upon the soil bearing capacity.

C. Any reinforcing steel added to the floor steel shall be without laps. The addition of such bars shall result in an even spacing of reinforcing bars including the floor reinforcing bars.

D. Concrete in circular spirally-tied columns, having no horizontal reinforcing crossing into the region bounded by the vertical reinforcement, may be deposited from the top of the column form such that no separation of the coarse aggregate from the mortar takes place.

E. Removal of column forms shall not be started any sooner than twelve hours of accumulated time with the ambient air temperature above 50°F after completion of the column pour.

3.07 CAST-IN-PLACE FLAT SLAB ROOF CONSTRUCTION

A. Roofs over 20,000 sq. ft. in surface area may, at the option of the Tank Contractor, have one or more construction joints. Such construction joints shall be approved by the Engineer prior to placement and shall include a continuous waterstop and galvanized or epoxy coated reinforcement through joint.

B. The roof shall be constructed to the dimensions and slope provided on the approved drawings. Provisions shall be made to ensure proper slope and reinforcing cover.

C. Roof formwork shall not vary from slope shown, more than ¼ inch in 10 feet or ½ inch maximum in 20 feet or more.

D. A curing compound which is compatible with the waterproofing coating system, if required, shall be applied to the roof in accordance with the Manufacturer's recommendations. Water curing may be used in conjunction with the curing compound.

3.08 CONCRETE

A. All concrete shall be conveyed, placed, finished, and cured as required by pertinent ACI standards.

B. Weather Limitations

1. Unless specifically authorized in writing by the Engineer, concrete shall not be placed without special protection during cold weather when the ambient temperature is below 35 degrees Fahrenheit and when the concrete is likely to be subjected to freezing temperatures before initial set has occurred and the concrete strength has reached 500 psi. Concrete shall be protected in accordance with ACI 306. The temperature of the concrete shall be maintained in accordance with the requirements of ACI 301 and ACI 306. All methods and equipment for heating and for protecting concrete in place shall be subject to the approval of the Engineer.

2. During hot weather, concreting shall be in accordance with the requirements of ACI 305.

3. Placement of concrete during periods of low humidity (below 50%) shall be avoided when feasible and economically possible, particularly when large surface areas are to be finished. In any event, surfaces exposed to drying wind shall be covered with polyethylene sheets immediately after finishing, or flooded with water, or shall be water cured continuously from the time the concrete has taken initial set. Curing compounds may be used in conjunction with water curing, provided they are compatible with coatings that may later be applied, or they are degradable.

C. Finishes

The tank shall be given the following finishes:

3. The floor slab shall receive a bull float finish or Fresno finish. The top of the wall footing, exterior to the waterstop, shall receive a steel trowel or magnesium trowel finish.

4. Column footings shall receive a steel trowel finish on the top surface and a form finish on the sides.

5. Columns shall have a form finish.

6. The interior surface of the tank wall shall have a form finish.

7. The top surface of the roof shall receive a light broom finish and a form finish on the bottom and edge surfaces.

D. Concrete Curing

1. Cure concrete in accordance with the methods specified herein for the different parts of the work and described in detail in the following paragraphs. These methods are considered to be minimum for curing. The conditions that exist in the field during placement and curing may require additional curing procedures and efforts to ensure proper protection and curing of the concrete. Select and implement the appropriate method commensurate with climatic conditions.

2. Cure floor slab using Method 1, 3 or 4 as specified below.

3. Cure exterior walls using Method 2 or 4 as specified below.

4. Cure roof slab using Method 3 or 4 as specified below.

5. Cure concrete for not less than 7 days after placing in accordance with the following methods:

a. Method 1, Water Spray Method: Tightly close off concrete surfaces to be cured by bulkheads or other means or entirely surround by tight enclosures, and keep the concrete surfaces moist by sprinkling, spraying, or other means.

b. Method 2, Wet-Burlap-Mat Method: Thoroughly wet and cover concrete surfaces to be cured with wet burlap mats as soon as the

forms have been stripped or as soon as the concrete has set sufficiently to avoid marring the surface. Keep entire concrete surface and burlap continuously and completely wet during the entire curing period.

c. Method 3, Curing Blanket Method:

i. Thoroughly wet concrete surfaces to be cured and cover with curing blankets as soon as the concrete has set sufficiently to avoid marring the surface. The curing blankets shall be weighted to maintain close contact with the concrete surface during entire curing period. Should the curing blankets become torn or otherwise ineffective, keep surfaces moist and replace damaged sections. The curing blankets shall consist of one of the following two types:

1. Sheets of heavy waterproof sisal-kraft paper laid with the edges butted together and with the joints between strips sealed with 2-inch-wide strips of sealing tape or with the edges lapped not less than 3 inches and fastened together with waterproof cement to form continuous watertight joints; or

2. Sheets of clean polyethylene, having a minimum thickness of 4 mils, laid with edges butted together and with the joints between sheets sealed with 1-inch-wide strips of acetate tape.

ii. During the curing period, do not permit traffic of any nature or depositing of objects, temporary or otherwise, on the curing blankets.

d. Method 4, Curing Compound Method:

i. Spray the surface with two coats of liquid curing compound. Apply in accordance with the manufacturer's instructions to cover the surface with a uniform film which will seal thoroughly. Apply second coat at 90 degrees to the first coat.

ii. Apply curing compound immediately after completion of the finish on unformed surfaces and within two hours after removal of forms on formed surfaces. Repair formed surfaces within the said two-hour period; provided, however, that any such repairs which cannot be made within the said two-hour period shall be delayed until after Method 1, 2, or 3 has been applied. When repairs are to be made to an area on which curing compound has been applied, first sandblast the area to remove the curing compound, then repair.

iii. Wherever curing compound may have been applied to surfaces against which concrete subsequently is to be placed and to which it is to adhere, remove the curing compound entirely by

abrasive blasting prior to the placing of new concrete.

iv. Where the curing compound method is used, exercise care to avoid damage to the seal during the curing period. Should the seal be damaged or broken before the expiration of the curing period, repair the damaged portions immediately by the application of additional curing compound.

E. Testing

1. For all concrete, two sets of five cylinders for the first 50 cubic yards, and one set of five cylinders for every 100 cubic yards thereafter placed in the same day. Two cylinders shall be tested at seven days, two at twenty-eight days, and one held as a spare.

2. Slump, air content and temperature testing shall be performed on each truck where cylinders are taken.

3. All concrete testing shall be in accordance with ASTM C31 and C39, at the expense of the Tank Contractor, and shall be conducted by an independent testing agency approved by the Engineer.

3.09 DECORATIVE COATINGS

A. If required by the Owner, all exterior exposed wall surfaces shall be given a two-coat finish of a non-cementitious 100% acrylic such as "Tammscoat Smooth" or equal. Work shall be performed by workmen skilled in the application of these types of products. The Manufacturer's application instructions shall be submitted to the Engineer for approval. The Tank Contractor shall confer with the Manufacturer's representatives regarding application techniques and shall follow the Manufacturer's instructions implicitly.

B. The concrete surface to be coated shall be clean, free of all laitance, dirt, grease, or other foreign materials. All defective surfaces shall be filled and/or repaired. Application shall be in full accordance with the manufacturer's instructions or as amended by the Engineer.

C. The Owner shall select the color.

3.10 DISINFECTION

A. The Tank Contractor shall, at the completion of tank construction, thoroughly clean the interior of the tank.

B. The Tank Contractor shall notify the Engineer prior to disinfecting the tank. Disinfection shall meet with the approval of the Engineer, AWWA C652, and the appropriate state agency.

C. The tank floor and interior of the wall shall be disinfected by using a solution of

chlorine and water per Method 3 of AWWA C652.

D. Prior to placing the tank in service, a bacteriological test shall be taken, and successful results received. Testing shall be by an independent testing laboratory at the expense of the Owner.

3.11 WATERTIGHTNESS TEST

A. Upon completion, the tank shall be tested to determine water tightness. The tank shall be filled with potable water to the maximum level. Water will be furnished to the tank by the Owner. The test shall consist of measuring the liquid level over the next twenty-four hours to determine if any change has occurred. If a change is observed and exceeds the maximum allowance, the test shall be extended to a total of five days. If at the end of five days the average daily change has not exceeded the maximum allowance, the test shall be considered satisfactory.

B. The test period shall be at least the theoretical time required to lower the water surface 3/8 inch assuming a loss at the maximum allowable rate. The test period shall be no longer than five days.

C. The liquid volume loss for a period of twenty-four hours shall not exceed $1/20^{th}$ of 1% of the tank capacity, 0.0005 x tank volume, as outlined in ACI 350.1 test HST-050. If the liquid volume loss exceeds this amount, it shall be considered excessive, and the tank shall be repaired and retested.

D. Damp spots will not be permitted at any location on the tank wall. Damp spots are defined as spots where moisture can be picked up on a dry hand. All such areas shall be repaired as necessary.

E. Damp spots or standing water on the footing may occur upon tank filling and are permissible within the allowable volume loss. Measurable flow in this area is not permissible and shall be corrected.

3.12 CLEAN-UP

A. The premises shall be kept clean and orderly at all times during the work. Upon completion of construction, the Tank Contractor shall remove or otherwise dispose of all rubbish and other materials caused by the construction operation. The Tank Contractor shall leave the premises in as good a condition as it was found.

END OF SECTION

SECTION 00440

GLASS-FUSED TO STEEL STORAGE TANK

PART 1 – GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, quality control inspection, fabrication, material testing and all other incidentals and labor required to design and construct a bolted, factory-applied, glass-fused-to-steel potable tank with an aluminum dome roof and all appurtenances, as specified herein.

B. Description of Tank:

1. The tank shall comply with AWWA D-103-97 and shall be a bolted glass-fused-to-steel design with nominal inside diameter and sidewall height as shown on the construction plans. The tank shall have a nominal capacity as shown on the construction plans. The tank shell panels shall be factory rolled to the required radius and shall be a flat panel design with bolted lap-joints using cured-in-place urethane sealant.

2. The tank roof greater than 36 foot diameter shall be an aluminum dome structure. The dome roof shall conform to AWWA D103-97, Section 13 and shall be a fully triangulated space truss complete with non-corrugated closure panels. The dome shall be clear span and self-supporting from the periphery structure with primary horizontal thrust contained by an integral tension ring.

3. The Contractor, in accordance with the minimum requirements shown on the Plans and specified, herein, shall provide the foundation. The tank shall be anchored to the foundation to resist seismic and wind forces. The foundation shall be as shown on the Plans and shall be designed by the tank manufacturer's engineering department. The foundation shall be AWWA D-103 Type 6.

4. All shell, floor and roof penetrations shall be adequately reinforced to transfer vertical, tangential and horizontal stresses, seismic load, and incidental differential settlement.

5. The following appurtenances shall be provided and located as indicated on the Plans (Unless noted otherwise; appurtenances in contact with the stored potable water shall be Type 316 stainless steel, appurtenances on tank exterior shall be Type 316 stainless steel). :

a. The Contractor shall supply an internal overflow with diameter area equal to the area of all inlet pipes. The overflow open end elevation shall be the maximum water surface elevation, as shown on the Plans. Suitable Type 316 stainless steel pipe supports, at approximately 10' intervals, shall be provided to prevent overflow pipe from moving. Nozzles thru the tank wall, if required by the Plans, shall be Type 316 stainless steel, full-face flange. The overflow may pass thru the tank floor and connect underground with the drain or it may pass thru the tank wall to an exterior 316 stainless steel flap valve (exterior concrete splash pad shall be provided). Overflow pipe shall be Schedule 80 PVC or C905 PVC where in contact with product water.

b. Separate tank inlet, effluent and washout connections shall be provided in diameters and at locations as shown on the Plans.

c. At least, one (1) Type 316 stainless steel shell manway with a minimum diameter of 24 inches shall be provided in the sidewall of the reservoir. The manway shall be placed with the centerline approximately 3.0 feet above the reservoir bottom. Manway shall have a watertight seal and the openings shall be suitably reinforced.

d. One (1) umbrella-type air vent fabricated from aluminum shall be provided. The vent opening shall be sized that differential pressure remains less than 0.5 inches of water column at 1,500 CFM in or out with screens in place. The vent insect and bird screens shall be non-corrosive monofilament polyester, aluminum or type 316 stainless steel.

e. One (1) outside Type 6061 T-6 aluminum ladder with Type 316 stainless steel cage shall be provided. An aluminum shield gate shall be provided for controlled access to the outside ladder.

f. One (1) aluminum watertight, gasketed roof hatch as shown on the Plans and as described later in these specifications.

g. A tank manufacturer approved cathodic protection system, utilizing suspended sacrificial magnesium anodes, shall be provided to protect the interior wetted surfaces of the tank. The anodes shall be suspended from fiberglass deck mounts which shall be installed using silicone sealant to prevent leakage through the dome. A corrosion engineer shall design the system and submit the design calculations for review by the Engineer. The cathodic protection system shall be designed for 10-year protection prior to anode replacement, based on the conductivity of the water stored and the exposed metallic surfaces.

1.02 REFERENCE DOCUMENTS:

(Reference documents shall be the latest edition of the publication unless otherwise indicated.)

A. International Conference of Building Officials (ICBO)

1. Uniform Building Code (UBC)

B. American Concrete Institute (ACI)

1. ACI 318-05 Building Code Requirements for Structural Concrete

C. American Society for Testing Materials (ASTM)

1. Standard Specifications as referenced.

D. American Water Works Association (AWWA)

1. ANSI/AWWA C651-99 AWWA Standard for Disinfecting Water Mains.

2. ANSI/AWWA C652-92 AWWA Standard for Disinfection of Water-Storage Facilities.

3. ANSI/AWWA D103-06 AWWA Standard for Factory-Coated Bolted Steel Tanks for Water Storage.

E. (HIOSH)

1. HIOSH Chapter 72, work Areas and Working Surfaces

1.03 SUBMITTALS:

A. Shop and Erection Plans:

1. Submit shop and erection Plans along with structural design calculations, stamped by a registered Structural Engineer with current licensing from the State of Hawaii.

2. Submit foundation Plans along with structural design calculations, stamped by a registered Structural Engineer with current licensing from the United States.

3. Submit a statement by tank engineer approving foundation Plans.

B. Product Data: Provide data on tank and dome materials, construction and accessories. Submit manufacturer's descriptive literature including accessories, components, and systems. Literature shall include detail specifications, available performance test data, and instruction for application and maintenance.

C. Tank Color: The exterior ceramic glass color shall be forest green. The interior tank color shall be titanium white. Manufacturer's color chart shall be submitted with the colors clearly identified.

D. Test Reports:

1. Furnish manufacturer's mil test reports for plate materials.

2. At conclusion of work, furnish a written report prepared by Contractor certifying that work was inspected in accordance with AWWA D103 Section 9. This report shall meet the requirements of Section 9 and cover hydrostatic test. Include in report a certification that construction conforms to approved Plans and specifications.

E. Certification: Submit a certificate signed by tank manufacturer's registered structural engineer providing the following information:

1. Description of structural design loading conditions used for design of entire tank including foundation.

2. Description of structural design method and codes used in establishing allowable stresses and safety factors applied in the design.

3. A statement verifying that structural design has been checked by experience engineers specializing in hydraulic structures.

4. A statement verifying that shop Plans have been checked by experienced engineers specializing in hydraulic structures to determine that they agree with design calculations, dimensions, and fabricating in member sizes, dimensions, and fabricating process as prescribed by ACI and AWWA standards.

F. Certificate for Microbiological Test: As required under item Testing and Disinfection.

G. Manufacturer's Installation Instructions: Indicate special procedures and installation instructions. Submit manufacturer's instructions for erection of tank. Instructions shall include, but not be limited to, bolt installation, sealant application, coating repair, foundation work and clean up.

H. Manufacturer's Certificate: Certify that products meet or exceed specified requirements and are suitable for intended use. Submit manufacturer's certification that tank has been manufactured in accordance with AWWA D103.

I. Report: Provide manufacturer's representative field observations.

1.04 PROJECT RECORD DOCUMENTS:

A. Submit project record documents to reflect actual installation conditions.

1.05 QUALIFICATIONS FOR TANK AND DOME MANUFACTURERS AND TANK ERECTORS (Require information to be submitted with Contractor's bid):

A. Tank Manufacturer: Company specializing in the fabrication of bolted, glass-fused-to-steel water tanks. All uncoiling, punching, radius rolling and glass-furnace operations shall be at one location. The manufacturer shall have fabricated and supplied, at least, ten (10) glass-fused-to-steel tanks of comparable or larger capacity in the past 12 months. Provide a list of current year tanks shipped, with the owner's name, contact persons and phone numbers.

B. Tank Erector: Company specializing in performing erection of glass-fused tanks with aluminum domes shall have successfully erected a minimum of ten (10) comparable diameter or larger glass-fused tanks with aluminum domes presently in full operational service in the State of Hawaii. Provide a list complying tanks, owners' name, contact person and phone numbers. This information shall be provided with bid.

C. Installation Crew: Installation of the tank shall be under the direction of the tank erector's factory certified tank builder and shall maintain the same foreman and crew from start to finish of work unless change is approved by Manager. Provide the names of the factory certified tank builders for each of the 10 tanks listed above. This information shall be provided with bid.

1.06 DESIGN CRITERIA:

A. Dimensions, elevations and location of penetrations and appurtenances shall be as located on the Plans and/or specified herein.

B. Design Loads

1. Dead load of the tank and its accessories, and live load of the contained static water, shall be as specified in AWWA D103-97. Design water depth shall be as shown on the Plans.

6. Roof Live Load: 25 psf uniform, in conformance with AWWA D103-97.

3. Wind Load: In accordance with AWWA D103-97, Base Wind Velocity 200 MPH or higher, if required on Plans.

4. Seismic Load: Design shall be in accordance with Section 12 of AWWA D103-97 using the effective mass approach in accordance with AWWA D103-97 Seismic Zone 3 or as indicated on the Plans.

C. Tank Design

1. Allowable design stress of steel for the tank shall be in accordance with AWWA D103-97.

2. No corrosion allowance shall be provided for shell plates. Cathodic protection shall be provided for wetted interior tank surfaces, as called for in these specifications.

D. Tank Foundation

1. Foundation shall be designed for a maximum allowable soil bearing pressure of 3000 psf or as indicated on the Plans.

2. Minimum depth of structural foundation shall be 12-inches below the finished grade. The top of foundation shall be 6-inches above finished grade. Tank reinforced concrete floor shall be a minimum of 6" thick and shall slope 1% to center drain.

3. Tank foundation shall be designed by the tank manufacturer's in-house licensed engineer.

1.07 TEST REPORTS:

A. The costs of all tests and reports shall be borne by the Contractor. Copies of the following tests shall be furnished:

B. Manufacturer's mil test reports for plate and roof framing materials.

C. Mil thickness test and holiday detection test for glass coating.

D. At the conclusion of the work, a written report prepared by the Tank Erector certifying that the work was inspected in accordance with Section 9 of AWWA D103-97. This report shall meet the requirement of Section 9 and also cover the hydrostatic test.

B. Microbiological tests in accordance with this section.

1.08 PRE-INSTALLATION CONFERENCE:

A. Attendance is to include Manufacturer's representative, Tank Erector, Contractor, Engineer, and representative of other trades affected by work of this Section.

1.09 MATERIAL HANDLING:

A. Deliver, store, protect and handle products with adequate protection against damage, and manufacturer's instructions.

B. Plates, members and miscellaneous parts shall be packaged for shipment in such a fashion to prevent abrasion or scratching of finished coating system.

C. Handle and store water storage tank systems, components, and parts to prevent distortions or other damages that could affect their structural or mechanical integrity. Store items that are subject to deterioration by exposure to elements off the ground, in a well-drained location, protected from weather, and accessible for inspection and handling.

D. Materials furnished for the water tank, which are found to be defective by the Owner's Representative, shall be rejected. All materials rejected must be removed from the project site immediately or within such time as allowed by the Owner's Representative and replaced with material of a quality acceptable to the Owner's Representative. Failure to reject any material or to require removal of any such rejected material shall not relieve the Contractor from responsibility as to the quality and character of material used or as any other obligations imposed upon him by the contract.

1.10 FIELD MEASUREMENTS:

A. Verify that field measurements are as indicated on shop Plans and as instructed by manufacturer.

1.11 COORDINATION

A. Coordinate work with work of others affected by work of this section.

1.12 SPECIAL WARRANTY:

A. Provide manufacturer's extended performance warranty stating that the wetted surfaces of the tank shall be free of corrosion, fish scaling and spalling for ten (10) years from date of installation.

PART 2 – PRODUCTS

2.01 TANK MATERIALS:

A. Bolted, Glass-Fused-to-Steel Tank:

1. Ceramic glass-fused tank
    i. The tank shall be for potable water storage and shall conform to AWWA D103-97 and the additional requirements specified herein.
    ii. Tank shall be an Engineered Storage Products Company Aquastore, Temcor or approved equal, with factory-applied glass-fused-to-steel components.
    iii. The exterior ceramic glass coating shall be forest green color and shall be a minimum of 11 mil in thickness.
    iv. It shall be free of holidays, fish scaling or other defects.
    v. The tank interior ceramic glass shall be titanium white color and shall be 7 to 11 mils in thickness.
2. Steel Sheet. After initial sheet preparation, all full height vertical wall sheets and all rectangular shaped floor sheets shall be beveled. A metal coating of 316 stainless steel shall then be applied to these edges by an ARC thermal spray of 1.5 to 5 mils (0.0015 to 0.005 inches). The coating shall have a tensile strength of >1500 psi (per ASTM C633-79).
3. Bolt Fasteners
    i. Bolts used in tank lap joints shall be ½" diameter hex head design.
    ii. Bolt Material shall be type 316 stainless steel, ASTM F593, Alloy Group 2, Condition CW1. Nuts and washers shall be type 316 stainless steel.
    iii. Where shear requirements cannot be satisfied with stainless steel bolting hardware, the bolts shall be ½" diameter – 13 UNC-2A rolled thread with galvanized coatings on bolt, nut and washer. These bolts shall meet the minimum requirements of AWWA D103, Section 2.2.
    iv. All bolts on the vertical tank wall shall be installed such that the head portion is located inside the tank, and the washer and nut are on the exterior.
    v. Bolt lengths shall be sized as to achieve a neat and uniform appearance. Excessive threads extending beyond the nut after torquing will not be permitted.

4. Tank Sheet Sealant/Caulk. Tank sheet sealant shall be cured-in-place urethane: Manus Bond, Sika Flex 1A or approved equal. Sealant shall be NSF Standard 61 approved. Rolled gaskets of neoprene or EDPM shall not be acceptable.

B. Aluminum Dome Roof:
1. Tank shall have an aluminum dome roof from one of the following manufacturers, or approved equal:
    i. CST Storage, 345 Harvestore Drive, DeKalb IL 60115
    ii. CST Domes, 150 West Walnut Street, Gardena CA 90248
2. Dome roof shall be constructed of non-corrugated triangular aluminum panels that are sealed and firmly clamped in an interlocking manner to a

fully triangulated aluminum space truss system of wide flange extrusions, thus forming a spherical dome structure.

3. The dome surface paneling shall be designed as a watertight system under all design load and temperature conditions. All raw edges of the aluminum panels shall be covered, sealed, and firmly clamped with batten bars in an interlocking manner to prevent slipping or disengagement under all load and temperature changes. The batten to panel sealing must be accomplished with an extruded gasket in full engagement with the formed panel and batten. The gasket engagement detail shall prevent any wiping action between the panel and gasket.
4. The dome shall be clear span and designed to be self-supporting from the periphery structure with primary horizontal thrust contained by an integral tension ring. The dome dead weight shall not exceed three (3) pounds per square foot of surface area.
5. The dome and tank shall be designed to act as an integral unit. The tank shall be designed to support an aluminum dome roof including all specified live loads.
6. Low rise: The dome shall be designed so that its total height above the tank ring shall not exceed 5'-0".
7. Materials:
    a. Triangulated space truss: 6061-T6 aluminum struts and gussets.
    b. Triangular closure panels: .050"t 3003-H16 aluminum sheet.
    c. Tension ring: 6061-T6 aluminum.
    d. Fasteners: 7075-T73 anodized aluminum or Series 300 stainless steel.
    e. Sealant and gaskets: 100% Silicone rubber.
8. Roof Vent:
    a. A properly sized vent assembly in accordance with AWWA D103 shall be furnished and installed above the maximum water level of sufficient capacity so that at maximum possible rate of water fill or withdrawal, the resulting interior pressure or vacuum will not exceed 0.5" water column.
    b. The overflow pipe shall not be considered to be a tank vent.
    c. The vent shall be constructed of aluminum such that the hood can be unbolted and used as a secondary roof access.
    d. The vent shall be so designed in construction as to prevent the entrance of birds and/or animals by including an expanded aluminum screen (2 inch) opening. An insect screen of 23 to 25 mesh polyester monofilaments shall be provided and designed to open should the screen become plugged.
7. Roof Hatch:
    a. Roof hatch shall be 30" square and shall be located as shown on the construction plans.
    b. Roof hatch shall be aluminum, shall include a lockable hasp and shall be mounted on a 4" curb with a 2" overhang. A gasket shall be provided to prevent entry of rainwater.
8. Safety Handrail:

a. Handrail shall be 1½" diameter, schedule 40 aluminum pipe. Handrail shall be in compliance with OSHA and ASPA requirements.
b. Handrail shall include a 4" high toe plate at the base of the stanchions.

9. Roof Access:
   a. Roof service area shall be coated in a non-skid material to provide a safe walking surface for maintenance personnel.
   b. Access from the exterior ladder to the roof shall include an aluminum checker plate gangway.

C. Concrete:

1. Concrete for the ringwall footing shall be in accordance with Manufactureres design standard to meet AWWA requirements.

2. Concrete floor coating. If AWWA D-103-97 Type 1 foundation is selected, tank floor shall be cleaned, acid etched and coated with potable water grade, NSF 61 approved Tnemec Elasto-Shield Series 264 modified polyurethane (minimum 50 mil DFT) or approved equal.

D. Work Specified in this Section:

1. The work to be performed under this section shall include the following:

   a. Furnish all labor, tools, equipment and materials necessary to complete all concrete work, complete in place, as shown on the plans.

   b. Coordinate work with all trades.

   c. Install bolts, anchors, metal frames and covers, and other inserts furnished by other trades. All anchors and inserts shall be installed using template.

E. Vapor barrier shall be 6 mil thick plastic sheets.

F. Base course under tank concrete slab shall conform to Water System Standards 2002.

G. Tank Accessories and Assemblies:

1. Ladders, Manway, Roof Hatch and Vent: Ladders, manway, roof hatch and vent shall be as shown on the plans.

2. All components shall conform to AWWA D103-97, with the ladders and cage meeting all OSHA requirements. Exterior ladder shall have a lockable gate at the bottom as shown in drawings.

C. Pipe straps shall be Type 316 stainless steel for interior straps and for exterior straps, unless indicated otherwise on the plans. Straps shall be placed at maximum intervals indicated on the plans and be of sufficient size for the pipe it supports.

PART 3 – EXECUTION

3.01 CONSTRUCTION:

A. Construct tank in accordance with AWWA D103-97 and in strict accordance with manufacturer's instructions. Install liquid level indicator and all other components as shown on the plans and in accordance with manufacturer's instruction, as may be amended by Owner's Representative as part of shop drawing review. Install vapor barrier in accordance with the manufacturer's instructions.

B. Anchor bolts shall not be driven but shall be set at time the concrete is placed and in the locations indicated on the approved shop Plans. This is required to limit corrosion impacts to concrete reinforcement.

3.02 SITE WORK:

A. Description:

1. This item of work shall include the furnishing of all labor, materials, tools, and equipment, necessary for completing this item of work as called out in the plans and specifications, and as supplemented hereinafter.

B. Excavation:

1. Excavation for structures shall not be carried below the elevations and beyond the dimensions shown. Over-excavation under structures and appurtenances shall be filled with lean concrete (BWS 2000) or compacted structural fill at no cost to the Owner, as directed by the Owner's Representative. Measurements for structure excavations shall be measured to dimensions of a neat structure line.

2. Bottom of footing trenches shall be compacted before pouring any concrete.

3. Foundation Testing. The contractor is responsible for performing all the foundation preparation and probing called for by the Geotechnical Investigation prepared for this tank and per specifications.

3.03 TESTING AND DISINFECTION:

A. Scope: Except as otherwise provided herein, furnish all equipment, labor and materials required for testing and disinfecting the water tank and all new pipelines, including valves and appurtenances. Water for testing and disinfecting shall be provided by the Owner. Disinfection shall be accomplished by chlorination in accordance with applicable AWWA procedures. All chlorinating and testing operations shall be done in the presence of the Owner's Representative. Disinfection operations shall be scheduled by the Contractor as late as possible during the contract time period so as to assure the maximum degree of sterility of the facilities at the time the work is accepted by the Owner's Representative. Results of the bacteriological testing shall be satisfactory with the Owner and the Utility Contractor. Release of water from structures and pipelines, after testing, disinfecting and neutralization of disinfected water have been completed, shall be approved by the Owner's Representative prior to release.

B. Execution:

1. Preliminary Cleaning and Flushing: Prior to both testing and disinfecting, the tank shall be cleaned by thoroughly hosing down all surfaces; all pipelines shall be thoroughly flushed or blown out, using a high volume of water or a cleansing pig.

2. Testing of Tank:

a. General: Testing shall not be performed until construction of the tank has been completed and shall be in accordance to AWWA D103-97. The test shall consist of filling the tank with water to the maximum operating water surface. After testing has been completed, water shall be disposed of as directed by the Owner's Representative. If suitable, water may be utilized in Owner's system.

b. Leakage Test and Repairs: After the tank has been filled, the leakage test shall be performed as follows: An initial water level reading shall be made. The tank shall be considered to have passed the test if water loss during the 72 hour period, as computed from the two water level readings, does not exceed 0.75 percent of the total volume of water in the tank. Should the tank fail to pass the test, the test shall be repeated for up to three additional test periods. If, at the end of 28 days, the tank still fails to pass the leakage test, the Contractor shall empty the tank as directed by the Owner's Representative and shall examine the interior for evidence of any condition that might be responsible for the leakage. Any evidence of leakage shall be repaired. Following these operations, the Contractor shall again test the tank.

3. Disinfection of Tank:

a. After all other work, including testing and painting, has been completed; the interior of the reservoir shall be thoroughly cleaned and disinfected in accordance with an appropriate method as included in AWWA C652-92. Disinfection shall not take place until tank sealant is fully cured (e.g. 5 to 8 days at 73E F /50% Relative Humidity).

b. Prior to starting any disinfection work, the Contractor shall submit to the Engineer a detailed outline of the procedures proposed, the coordination and sequence of operation, and the manner of filling and flushing the reservoir. All procedures shall be acceptable to the Engineer.

c. Corrections, when required, shall be in accordance with the requirements of this Specification.

d. The Contractor shall furnish all labor, materials, equipment and incidentals necessary for the cleaning and disinfecting operations. Water shall be supplied as described in the Special Conditions.

e. All water used in cleaning and disinfecting the reservoir and which is to be wasted shall be disposed of in a manner acceptable to the Engineer and in accordance with all local regulatory requirements.

f. After the reservoir has been filled, after disinfection, samples will be taken by the Engineer for bacteriological or aesthetic quality; the reservoir shall be completely drained and re-disinfected by the Contractor.

END OF SECTION

SECTION 00500

DISINFECTION OF POTABLE WATER TANKS

PART 1 – GENERAL

1.01 SUMMARY

This section describes the requirements for disinfecting a water tank or reservoir.

1.02 REFERENCES

AWWA C652-92-Disinfection of Water Storage Facilities

1.03 MEASUREMENT AND PAYMENT

This work is incidental to the erection of the tank, and the Contractor shall not receive any extra payment for this work. Compensation shall be included in the price stipulated in the contract.

PART 2 – EXECUTION

2.01 PREPARATION AND TEMPORARY PROVISIONS

Injection Points: Provide temporary saddle and corporation stop for the purpose of injecting chlorinated solution (if chlorination method 1 is chosen).

Sample Tap: Install a corporation stop saddle and sampling bib in the check valve vault for bacteriological sampling. Consult with the Project Engineer regarding the placement of the saddle.

2.02 DISINFECTION

Chlorination Method: Choose one of the following methods of AWWA C652-92 for disinfecting the water tank.

1) **CHLORINATION METHOD 1**:

   Fill the tank to the overflow level with potable water with chlorine added to bring the free chlorine residual to a level that will result in 10 mg/l.

   If the water was chlorinated continuously during filling, the retention period shall be 6 hours. If the water was chlorinated by adding sodium or calcium hypochlorite within the tank, the retention period shall be 24 hours.

After the chlorination period, the free chlorine residual shall be decreased below 2mg/l via dilution with potable water and tested for bacteriological safety.

2) **CHLORINATION METHOD 2**:

Apply a solution of 200 mg/l available chlorine directly to the interior surfaces of the reservoir, including the inlet and outlet piping interior.

Application Methods: Apply with suitable brushes or spray equipment.

Retention: Ensure that the surfaces remains continuously wetted with the required solution for at least 30 minutes.

Bacteriological Testing: Fill the tank with potable water to bring the free chlorine residual below 2mg/l, and then sample for bacteriological safety.

3) **BACTERIOLOGICAL TESTING RESULTS**

If, after disinfection activities are complete, a positive bacteriological result is obtained, consult with the Project Engineer as to whether re-chlorination is necessary.

Provide two negative bacteriological results to demonstrate that a positive bacteriological problem has been remedied.

4) **DISPOSAL OF CHLORINATED WATER**

Waste flushed disinfection water in an environmentally safe manner and AS-EPA approved. In no case shall direct disposal to surface water be permitted.

Check the chlorine residual at time of disposal.

If disposal to a community sewer system is available, neutralize the chlorine residual if the free residual is above 10 mg/l.

If disposal is to the ground surface or ditch, neutralize the chlorine residual if the free residual is above 1 mg/l.

Use the following neutralization chemical schedule:

a) Sodium Dioxide at 0.8 lb/100,000 gals/mg/l of free chlorine.
b) Sodium Bisulfite at 1.2 lb/100,000 gals/mg/l of free chlorine.
c) Sodium Sulfite at 1.4 lb/100,000 gals/mg/l of free chlorine.
d) Sodium Thiosulfate at 1.2 lb/100,000 gals/mg/l of free chlorine.

END OF SECTION

SECTION 00600

CATHODIC PROTECTION FOR WATER TANK

(SACRIFICIAL ANODE)

PART 1 – GENERAL

1.01 SECTION INCLUDES

1. Requirements for sacrificial anode cathodic protection systems for the interior submerged surfaces of steel water storage tanks.
2. Specifications for anodes, wiring, test station and long life reference electrodes.
3. Requirement that all materials in contact with the water or exposed to the interior of the tank to be classified in accordance with ANSI/NSF 61 - Drinking Water System Components.
4. Reference to the National Electrical Code (latest edition) which is part of this specification.

1.02 RELATED SECTIONS

1. Section 01110 – Summary of Work.
2. Section 01330 – Submittal Procedures.
3. Section 01351 – Environmental Safety and Worker Protection.
4. Section 13113 – Cathodic Protection for New Tank Bottoms.
5. Section 13201 – Welded Steel Water Storage Tanks.

1.03 UNIT PRICES

1. There is no separate measurement and payment for work performed under this Section. Include the cost for this work in the contract bid price for work of which this is a component part.
2. Payment will be full compensation for all labor, equipment, materials and supervision for the installation of the cathodic protection system, complete in place including anodes, reference cells, wiring, and all field welding, connections, adjustments, testing, cleanup, and other related work necessary for construction as shown on the Drawings and specified herein.

1.04 REFERENCES

1. ANSI/NSF 61 - Drinking Water System Components.
2. ASTM D1248 – Polyethylene Plastics Extrusion Material for Wire Cable.
3. AWWA D100 - Standard for Welded Steel Tanks for Water Storage.

4. AWWA D102 – Standard for Painting Steel Water-Storage Tanks.
5. National Electrical Code.
6. NEC 70 - National Electrical Code (latest revision).
7. DOT 199 – Federal Substance Abuse and Testing Regulations.
8. UL 83 - Thermoplastic-Insulated Wires.
9. UL 467 - Bonding and Grounding Equipment.
10. UL 486A - Wire Connectors and Soldering Lugs for Use with Copper Conductors.

1.05 SUBMITTALS

1. General: Submittals to conform to the requirements of this specification.
2. Design Drawings and Computations: Prepare all computations and drawings by or under the direct supervision of a Corrosion Engineer who is a Professional Engineer, registered in the United States with a minimum of ten years' experience in cathodic protection design for water storage tanks. Design the system to provide effective corrosion control in accordance with the criterion for protection which is a tank-to-water potential, IR drop free, within a range of -0.850 volts to -1.050 volts relative to copper-copper sulfate reference electrode. Measure this potential free of the effect of voltage gradients (IR drops).
   The Corrosion Engineer to base system capacity on:
   i. Total surface area of the tank. Total surface area includes to the high water level (HWL) in bowl and wet risers in elevated tanks, which are 30 inch diameter or larger.
   ii. High quality interior coating.
   iii. Protection of bare steel surfaces due to coating deterioration of up to 20% of the total submerged surface area.
   iv. Chemical analysis of water including resistivity.
   v. Minimum anode system life of twenty (20) years.
3. Provide certificate, signed and sealed by Professional Engineer stating that computations and Drawings are in conformance with these design criteria.
4. Catalog Cuts: Submit manufacturer's catalog cuts for the system which demonstrates classification in accordance with ANSI/NSF 61 - Drinking Water System Components.
5. Operating and Maintenance Manual: Submit five (5) operating, monitoring and maintenance manuals for the cathodic protection system. Include operating instructions, maintenance data, product data and test procedures in the manuals.
6. Drawings: Maintain as-built Drawings of the corrosion system during installation and construction. Revise drawings to show exact locations of all wiring, connections and terminal boxes. Properly identify all items of equipment and material. Submit the original as-built Drawings to the Owner representative.

1.07 QUALITY CONTROL

1. Certification: Provide manufacturer's certification that all components of the cathodic protection system meet the requirements of the Drawings and specifications.
2. Drawings: The Drawings for the cathodic protection systems are diagrammatic. Do not scale the Drawings for exact locations unless scales are explicitly stated on the specific drawing. Determine exact locations by field conditions and non-interference with mechanical and structural features.
3. Inspection: All materials, fabrication and installations are subject to inspection and testing by the Owner or its designated representative.

1.08 QUALIFICATIONS

A minimum of five years' experience installing and servicing the types of system described in this specification is required of the Cathodic Protection Contractor. Install the system by employees of the Cathodic Protection Contractor who have experience in the installation of water tank systems. All personnel subject to Federal Substance Abuse and Testing Regulations as required by the Owner.

1.09 RECOMMENDED CONTRACTOR

Corrpro US, Houston Office, 7000 B Hollister, Houston, TX 77040; www.corrpro.com

PART 2 – PRODUCTS

All materials in contact with the water or exposed to the interior of the tank are to be classified in accordance with ANSI/NSF 61 "Drinking Water System Components".

2.01 ANODES

1. General: Anode material to be high potential magnesium, having a diameter of 2.024 ±0.024 inches, extruded on a solid, 1/8 inch steel core with nominal length of 10 feet for each anode.
2. Composition: High potential magnesium alloy to conform to the following:

i.	Element	% by Weight
ii.	Silicon	0.05 maximum
iii.	Copper	0.01 maximum
iv.	Nickel	0.001 maximum
v.	Iron	0.002 maximum
vi.	Aluminum	2.5 – 3.5
vii.	Zinc	0.7 – 1.3
viii.	Manganese	0.2 minimum

ix.	Other	0.3 maximum
x.	Magnesium	Remainder

3. Anode Lead Wire: Use No. 8 AWG stranded copper wire with medium density, high molecular weight polyethylene (HMW/PE) insulation. Polyethylene to conform to ASTM D 1248, Type I, Class C, Grade 5.
4. Connection: Connect the anode-to-wire with a Thomas & Betts, C tap, crimp connector sized for No. 8 AWG stranded copper conductor. First crimp the wire to the 1/8-inch anode core and then silver solder to ensure electrical continuity and strength.
5. Anode Eye Ring: Drill and tap the end of the anode to a depth of 1-1/2 inches adjacent to the core wire. Screw a 3/8-inch diameter eye ring with a 3-inch shaft and a 1-inch inside diameter eye loop, 1-½ inches into the anode.
6. Encapsulation: Encapsulate the crimped connection and the shaft of the eye ring in epoxy. See Drawings.

2.02 MONITORING STATION

1. Enclosure: Use a NEMA 4X enclosure for the cathodic protection system monitoring station.
2. Meter: Cathodic protection potential/anode current DC voltmeter to have a push to read button connecting the permanent reference cell to the digital voltmeter with an internal resistance of not less than 1,000,000 ohms/volt and a minimum full scale of 1999 mV.
3. Shunt: Place a calibrated shunt in the anode circuit wired to the DC voltmeter for measuring DC current.
4. Resistor: Equip the monitoring station with a variable resistor (rheostat) sized not less than a 100 watt, 100 ohm, connected between the anode header cable and the tank lead wire.
5. Tank Negative Lead: Use No. 8 AWG stranded copper with THHW insulation for the system ground.
6. Test Lead: Install independent structure test lead not smaller than No. 18 AWG stranded copper TW or THHW insulation on the potential test circuit.
7. Tank Connections: Space the anode system structure and test structure connections six (6) or more inches apart on ladder stand-off welded to tank shell. Connect with brass bolts as shown on Drawings.
8. Monitoring Station Mounting: Locate the monitoring station on the exterior of the tank for convenient operator serviceability approximately five (5) feet off the ground near the ladder.

2.03 REFERENCE ELECTRODES

1. General: Install two (2) copper-copper sulfate electrodes, manufactured with 99.99% pure copper coiled element. Cells are to remain stable (plus or minus 10 mV) in fresh water for a minimum of ten years.

2. Lead Wires: Use No. 14 AWG stranded copper wire with blue, medium density, high molecular weight polyethylene (HMW/PE) insulation for the reference cell lead wire. Polyethylene to conform to ASTM D 1248, Type I, Class C, Grade 5.
3. Encapsulation: Encapsulate the reference electrode to lead wire connection in epoxy to prevent water penetration.

2.04 ANODE SUSPENSION SYSTEM

1. Cord: Suspend the anode from a minimum 5/16 inch diameter polyester cord, tied to the anode eye ring and anchored to the roof of the tank as shown on the Drawings.
2. Lead Wires: Do not use the anode lead wire to support the weight of the anode.

2.05 ANODE HEADER CABLE

1. General: Use No. 8 AWG stranded copper, HMW/PE insulated cable. Install header cable without cutting any strands of copper and run from each anode completing a full 3600 circle. Extend both ends of the anode header cable to the monitoring station where one end will terminate on a variable resistor. Connect the other end of the resistor to the tank with a No. 8 AWG copper wire. Terminate the other end of the header cable with a wire nut.
2. Interior Wiring: Insulate all wiring within the tank to prevent copper conductor contact with the potable water.
3. Exterior Wiring: Use stranded copper conductors, run in rigid, galvanized steel conduit for all wiring on the exterior of the tank.

2.06 ANODE CONNECTIONS

1. Connectors: Use a Thomas & Betts, C tap, crimp connector for a No. 8 AWG stranded to No. 8 AWG stranded copper wire connection for the anode lead wire to header cable splices.
2. Sealant: Seal splices between anode lead wires and collector cable with Scotchfill Insulation Putty, Scotch 130C Rubber Tape, and Scotch Super 88 Plastic Tape as manufactured by 3M. Coat the completed splice with Scotchkote.

2.07 HARDWARE

All hardware used in conjunction with the system to be provided with a protective coating to protect against corrosion

PART 3 - EXECUTION

3.01 PERFORMANCE

1. Perform all work in accordance with the following requirements:
2. General: Install components of the cathodic protection system in the manner and at the locations shown on the Drawings prepared by the Corrosion Engineer.
3. Inspection: Prior to installation, have the Owner or its designated representative, inspect materials and equipment. Replace any defective materials or components that do not satisfy the requirements of this specification.
4. Tank Attachments: All attachments to the interior, wetted surfaces of the tank should be constructed of non-metallic materials or mild steel that is provided with the same protective coating system as the tank shell. Where stainless steel accessories are used, such as ladders or safety rails, the stainless steel shall be electrically isolated from the tank.
5. Welding, Cutting and Coating: Follow AWWA Standards D 100 and D 102 for welding, cutting, and coating.
6. Electrical Continuity: Assure continuity by spot welding all sections of bolted or riveted tanks. Tank Construction Contractor to perform the welding.
7. Wiring: Handle and install lead wires to prevent damage from abrasion.
8. Connections: Seal electrical connections within the tank to prevent water penetration.
9. Monitoring Station: Mount the monitoring station at a convenient height (eye level) above grade for monitoring and service purposes.
10. Disinfection: The Tank Construction Contractor is responsible for disinfection.
11. Workmanship: Complete the work in a clean and safe manner.
12. Tank Closure: Security of all tank access locations (e.g. hatches) is the responsibility of the Owner.

3.02 ENERGIZING SYSTEM

1. General: After the system is installed and the tank is filled, provide startup service, which includes energizing, testing, and adjusting the system for optimum performance.
2. Prior to native state, polarized potential testing and commissioning of the system, give a minimum of 48 hours notice to the Owner, Engineering Project Manager to facilitate observation of the tests by an Owner Representative.
3. Method: Record all tank-to-water potential measurements with a calibrated, portable, copper-copper sulfate reference electrode and a portable, high impedance voltmeter. Measure native state, current “on” and “instant off” potentials at a minimum of five locations within the tank. Record potential and current measurements at the monitoring station.
4. Report: Review and evaluation of all test data is the responsibility of the Corrosion Engineer. In addition to the startup service, submit “as-built” drawings and an Operations and Maintenance Manual in accordance with Section 1.05.

END OF SECTION