SECTION 33 16 00

3.0 MG Prestressed Concrete Tank

PART 1 - GENERAL

1.01 SUMMARY OF WORK

A. It is anticipated that the AWWA D110 prestressed concrete water utility storage tank will be designed and constructed on site by a contractor (Tank Constructor) that specializes in wire wrapped prestressed tank construction.

1) Furnish all labor, materials, and incidentals required to design, construct, and test a 3,000,000 gallon, 120 feet inside diameter, circular wire wrapped prestressed concrete tank, as illustrated on the Drawings, and as specified herein.

2) Furnish and install all piping and fittings to the limits as shown on the Drawings and as specified herein.

3) Tank Constructor to provide pipe support design for the piping located inside of the storage tanks.

4) Design of the storage tanks and the tank foundation to be delegated to the Tank Constructor.

1.02 PRODUCT SUBMITTALS

A. Product Data: information, details, and specifications for the tank appurtenances. Appurtenances include the follow

1) Inlet, outlet, overflow, and drainpipes.

2) Ladders, hatches, and railings.

3) Roof ventilator(s).

4) Perimeter concrete ventilator(s).

5) Wall Manways

6) Liquid Level Indicators.

7) Exterior coating information and color samples

1.03 DELEGATED DESIGN SUBMITTALS

A. Design Data

1) Submit the design calculations stamped by a professional engineer licensed in the State of Florida (Tank Constructor's Engineer) as confirmation of the delegated design.

B. Assembly Drawings:

1) Assembly drawings and construction procedures sealed by Tank Constructor's Engineer.

2) Provide details for the foundation, floor slab, walls, roof construction, piping, and other details and accessories necessary to construct the water storage tank.

C. Certification

1) The Tank Constructor is responsible for the design and construction of the prestressed concrete tank(s). Submit written certification prepared, sealed, and signed by a professional engineer licensed in the State of Florida (Tank Constructor's Engineer) that the design, details, and construction conform to the requirements of AWWA D110, and applicable local and Latest Edition of the Florida Building Code.

1.04 QUALIFICATION SUBMITTALS

A. Statement of Qualification.

1) Submit summary of Tank Constructor's experience record in the design and construction of AWWA D110 wire wrapped prestressed concrete tanks.

1.05 QUALITY ASSURANCE

A. Perform Work according to the current AWWA D110-13 (R18), or latest edition, standard, Wire Wound, Circular, Prestressed Concrete Water tanks with Type II Core Walls and applicable portions of ACI 372R latest edition, Design and Construction of Circular Wire Wrapped Prestressed Concrete Structures.

1.06 QUALIFICATIONS

A. The Tank Constructor shall be a corporation specializing in wire wrapped tank design with a minimum ten years' documented experience in Florida in the design and construction of wire wrapped circular prestressed concrete tanks

B. All excavation, backfill, grading and concrete work shall be under the supervision and responsibility of the Tank Constructor including the base slab and foundation. The Tank Constructor shall have designed and constructed at least five similarly sized wire wrapped prestressed concrete tanks with domed roofs conforming to AWWA D110 with Type II core wall(s) that have been placed into service within the last 10 years in Florida

1.07 WARRANTY

A. Warranty the tank structure against any defective materials or workmanship for a period of 5 years from the date of placing in service.

B. If any leaks or other defect appears with in the 5-year period, upon written notice by the Owner that such defects have been observed, the Tank Constructor shall within 5 days inspect and subsequently immediately initiate a repair program.

PART 2 - PRODUCTS

2.01 SYSTEMS

A. Tank:

1) Wire wrapped prestressed concrete tank with a Type II core wall.

B. Acceptable Tank Constructors:

1) CROM Corp., Gainesville, FL

2) Precon Corp., Newberry, FL

3) Approved Equal

2.02 PERFORMANCE AND DESIGN CRITERIA:

A. Tank Construction:

1) Floor: cast-in-place reinforced concrete.

2) Floor thickness: design by Tank Constructor's Engineer with minimum thickness of 4-in.

3) Provide thickened edge for the exterior wall footing design by Tank Constructor's Engineer.

4) Floor Slabs greater than 4-inches: provide top and bottom reinforcement in each direction.

5) The transition from the bottom of the footings and pipe encasements to the underside of the floor slab shall not be steeper than 2 horizontal to 1 vertical. The pipe encasements shall not be less than the OD of the pipe plus 6-in on all sides of the pipe. The clearance in all directions shall not be less than 12-in.

6) Floor/Wall Joint: detailed to allow translation and rotation.

7) Wall: AWWA Type II Shotcrete core wall with steel diaphragm.

8) Horizontal prestressing shall be continuous; discontinuous prestressing tendons or strands will not be allowed.

9) Wall/Roof Joint: detailed to prevent translation and allow partial rotation.

10) Roof: precast prestressed or a cast-in-place concrete dome with a minimum thickness of 3-inches; dome shall have one-tenth rise and free-span.

B. Minimum Design Loads: (design loads to be established by the Tank Structural Engineer but shall not be less than listed minimum values)

1) Live Floor Load:

a. Floor: 62.4 lbs/ft3 times the height of water to overflow in feet plus 6-in.

b. Concrete membrane floors, if allowed by the soils bearing capacity, shall be a minimum of 4 inches thick.

c. Concrete over pipes and encasement shall be a minimum of 8 inches thick.

2) Roof Live Load

a. The minimum roof live load shall be 12 psf.

3) Wind Load:

a. Ultimate Design Wind Speed: 170 mph.

b. Exposure Category: C.

c. Risk Category: IV (Critical Infrastructure)

4) Soil Bearing: Unless a higher value is confirmed by a geotechnical investigation and evaluation signed and sealed by a professional engineer licensed in Florida, the allowable Soil Bearing Pressure shall not exceed 2,300 psf.

2.03 COMPONENTS

A. Materials including reinforcing, concrete, and shotcrete hall conform to AWWA D110 current edition and the following standards.

B. Concrete:

1) Admixtures causing accelerated or retarded set of the concrete are not allowed unless approved in writing by the Structural Engineer.

2) Concrete Strength: Minimum concrete strength at 28 days.

a. Pipe Encasement, f'c = 3500 psi

b. Footing and floors f'c = 4500 psi

c. Dome roof f'c = 4000 psi

d. Shotcrete Mix (core walls and overcoat) f'c = 4000 psi

C. Prestressed Wire:

1) Conform to ASTM A821, suitable for redrawing and having a minimum ultimate strength of 210,000 psi, unless otherwise approved in writing by the Structural Engineer.

D. Shotcrete:

1) In accordance with AWWA D110.

2) Galvanized Steel Diaphragm

a. Conform to ASTM A653/A653M steel. Minimum 26-gauge thickness (0.017 inch), vertically ribbed with reentrant angles spaced not more than 3-in apart and depth of 3/8-in.

b. Vertical joints roll seamed, crimped, and sealed watertight with epoxy injection.

c. The steel diaphragm shall be epoxy bonded to the waterstop at the floor joint.

E. Elastomeric Materials:

1) Waterstops

a. Extruded from elastomeric plastic compound with virgin polyvinyl chloride as the basic resin. Configuration as recommended by the Tank Constructor.

b. Floor to wall joint bearing pads shall be neoprene.

c. Moisture Barrier between subgrade and floor: Polyethylene Class A conforming to ASTM E1745. The thickness shall not be less than 6 mil.

F. Appurtenances:

1) Ladders:

a. Exterior aluminum ladder and interior fiberglass ladder shall be at locations shown on the Drawings. Ladders, ladder accessories, and ladder cages shall conform to current OSHA requirements.

b. Exterior ladders shall be provided with walk-through rail extension extending not less than 42-in above the landing. Rail extensions shall conform to current OSHA requirements.

c. The ladders shall be fitted with a fall prevention device conforming to OSHA requirements. This device shall be a SAF-T-CLIMB fall prevention device. The interior ladder shall be fitted with a SAF-T-CLIMB Removable Extension by North Consumer Products or equal. Two climbing belts shall be provided to the Owner. Provide type 316 stainless steel hardware and fasteners, accessories.

2) Roof Hatch:

a. Material: Fiberglass or aluminum, hinges, fasteners, and accessories stainless steel

b. Opening: 42-inches square minimum.

c. Hatch:

i. Provide hold open device that shall automatically lock when the door is in the fully opened position.

ii. Provide Type 316 stainless steel hardware throughout.

iii. Provide Type 316 stainless steel anchor system for attachment to concrete curb on roof.

iv. Provide continuous water-tight gasket.

3) Handrail and Guardrail:

a. Material: aluminum

b. Standards: all components shall conform to current OSHA standards and Latest Edition Florida Building Code.

c. Extend a minimum of six feet on either side of the exterior ladder.

d. Provide vertical posts at a maximum spacing of 5-ft on center; provide ¼ thick by 4-inch toe board (kick plate); provide 42-inch-high smooth top rail and mid rail.

e. Install two stainless steel safety chains with hooks at the ladder. Install chains at the top and mid rail.

4) Ventilator(s):

a. Material: Fiberglass.

b. Provide 24 mesh Type 316 stainless steel fail-safe pop out insect screen

in case of blocked up screens.

c. Provide suitable anchor system for attachment to roof dome.

d. Design for operational and rapid draw down events.

e. Opening: 50-inches diameter minimum.

f. Provide suitable Type 316 stainless steel anchor system for attachment to concrete curb on roof. Include 316 stainless steel cable from guide rail near hatch to stainless steel anchor to allow for personnel attachment with five-point harness.

g. Provide continuous 1/4-inch thick, 60 durometer neoprene sheet gaskets under ventilator flange. Fasten flange through gasket.

h. "Eye lid" Ventilator(s): Precast concrete located on the dome near the edge, shall not be used as overflows. Provide 24 mesh Type 316 stainless-steel fail-safe pop out insect screen in case of blocked up screens.

5) Wall Manway:

a. Watertight elliptical shape made of Type 316 stainless steel.

b. Clear Opening: 18-in vertical by 52-in horizontal minimum.

c. Cover plate with a stainless-steel hinge shall be mounted on the inside.

d. Provide gasket between manway cover and wall sleeve and attached to the manway cover.

e. Manway shall be capable of being "dogged" tight from the exterior of the tank. The "dogs" shall have provisions for being padlocked.

6) Liquid Level Indicator:

a. Position as shown on the Drawings.

b. Include port for (4) floats.

c. Half travel gauge with an interior float.

d. Glass: Fiberglass with 4-in black numbers on a white board.

e. Level Indicator: Red fiberglass target.

f. Zero Mark: Set even with the top of the tank wall.

g. Interior Float: Fiberglass guided vertically true.

7) Include port for pressure transducer.

8) Pipe support brackets in tank shall be stainless steel. See Drawings for pipe required and provide supports to rigidly hold the pipe.

2.04 COATINGS

A. Exterior tank colors shall be selected by Owner during the shop drawing process.

B. Interior Coatings

1) All interior metal surfaces (including but not limited to pipes and pipe supports)

a. Surface preparation: Pressure wash at 4,000 psi and abrade primer with sandpaper to develop a surface profile.

b. Prime coat: Apply Tnemec Series 20 HS at 4 to 6 mils DFT.

c. Stripe coat: Apply Tnemec Series 20 HS at 4 to 6 mils DFT to all edges and sharp points with a brush or roller to within 3 inches of the edge.

d. Spot prime: Apply Tnemec Series 20 HS at 4 to 6 mils DFT.

e. Topcoat: Apply Tnemec Series 22 at 18 to 28 mils DFT.

C. Exterior Coatings

1) Exterior tank walls and dome

a. Surface Preparation: Remove all contaminants by power washing per SSPC-SP1.

b. First Coat: Tnemec Series 156 Enviro-Crete 4.0 to 6.0 mils DFT

c. Second Coat: Tnemec Series 156 Enviro-Crete 4.0 to 6.0 mils DFT

PART 3 - EXECUTION

3.01 INSTALLATION

A. Reinforcing Steel:

1) Reinforcing steel: Install in accordance with the CRSI, Code of Standard Practice.

B. Placing Concrete:

1) General Placement:

a. Cast-in-place concrete floor and roofs: Install in accordance with ACI 318 and ACI 350R.

b. In hot weather, concrete, when deposited, shall have a placing temperature that will not cause difficulty from loss of slump, flash set, or formation of cold joints. In no case shall the temperature of concrete being placed exceed 90 degrees F.

2) Floor Slab:

a. Prior to placement of the floor slab, place a 6-mil polyethylene moisture barrier over the subbase. Overlap joints in the polyethylene a minimum of 6-inches.

b. The floor slab including the thickened portion for the wall footing shall be placed in one continuous concrete placement. Construction joints between the floor slab and footings shall not be allowed. Where a construction joint is approved in writing by the Engineer, the joint shall have 6-in wide, 3/8-in thick PVC meeting the same requirements as the wall to base slab waterstop.

c. The tank floor shall be wood/bull float finished first. Subsequently the floor shall receive a hard, durable fine finish by the steel trowel method or by use of power finishing machines. No water shall be added to the slab during finishing. Curing of the tank floor shall be accomplished by ponding the entire area with 2-inch minimum of water within 24 hours after concrete placement. The floor shall be kept ponded for a minimum of 7 days.

3) Dome:

a. All concrete shall be consolidated by means of a vibrator for proper encasement of reinforcing steel and welded wire fabric.

b. All surfaces at the joint between the wall and the dome shall be coated with bonding epoxy.

c. Plastic bolsters shall be used to support reinforcing steel and welded wire reinforcement to ensure positive control on placement of steel.

d. The exterior surface of the dome shall receive a light broom finish.

e. The dome shall be water cured for a minimum 7 days after casting or until dome band prestressing is completed.

C. Core Walls

1) Prestressed Core Wall(s):

a. Exterior wall and exterior dome tension ring details including the steel diaphragm, PVC waterstops, elastomeric bearing pads, sponge rubber fillers, prestressing steel, prestressing earthquake cables, and shotcrete shall conform to the requirements of AWWA D110.

b. A PVC waterstop shall be installed in the wall to base joint. Field splices shall be in accordance with the manufacturer's specifications. The waterstops shall be installed so as to form a continuous watertight dam. Adequate provisions shall be made to support and protect the waterstop during the progress of the work. Where the waterstop is placed in a concrete cove attached to the inner face of the wall, the cove shall attain 60 percent of its 28-day strength prior to the start of prestressing the wall.

c. Circumferential Prestressing

i. Stress readings on a calibrated stress meter, furnished by the Tank Constructor, shall be made on every tenth prestressing wire, or a minimum of one reading per vertical foot for each layer. A running log shall be maintained by the Tank Constructor of the stress readings and used to determine the final number of wires required.

ii. In computing the final tension in the wires, an allowance for prestress loss due to creep, shrinkage, elastic deformation, and residual compression shall be provided for. The Tank Constructor shall submit an "as-built" revision to the design diagram showing the location and number of wires actually used for the project records only.

d. Shotcrete

i. No prestressing wire shall remain exposed during inclement weather over a holiday or weekend, it shall be covered with shotcrete and subsequently wet cured.

ii. Vertical shooting wires shall be installed to establish uniform and correct thickness of shotcrete. Shooting wires shall be at 2-ft on center around the circumference of the tank, or as otherwise recommended by the Tank Constructor. The final coat shall be applied true to shooting wires so as to form a smooth cylindrical surface.

iii. At the end of the day's work, or similar stoppage period, the shotcrete shall be sloped off at an angle of approximately 45 degrees. Before placing adjacent sections, the sloped portions shall be thoroughly cleaned by air and water blast. Shotcrete with a strength lower than specified shall be removed and replaced.

iv. Shotcrete shall be cured by keeping the shotcrete continuously wet for 7 days. Natural curing may be allowed if the relative humidity is at or above 85 percent.

v. Dry mix/wet mix shotcrete shall receive a gun finish free from ridges or other defects.

D. Ladders

1) Ladders, exterior and interior, shall be installed at locations shown on Drawings. Ladders, ladder accessories and ladder clearances shall be installed per OSHA minimum requirements.

2) Ladder supports shall be installed by type 316 stainless steel expansion bolts or type 316 stainless steel bolts with cast-in-place threaded inserts. Prior to installing expansion bolts, the reinforcing bars shall be located and marked with a "rebar locator" supplied by the Tank Constructor to avoid cutting reinforcing.

E. Roof hatches

1) Roof hatch(es) shall be installed at locations shown on the Drawings. The hatches shall be installed on a concrete curb with a minimum height of 4-in and a minimum of 6-in wide. The hatches shall be installed with a watertight gasket and stainless-steel concrete anchors.

F. Handrail and Guardrail

1) Handrail shall be installed at locations shown on the Drawings. The handrails shall be installed to conform to the requirements of OSHA and the Florida Building Code.

2) Installation of the handrails shall be either by stainless steel expansion bolts or cast-in- place threaded inserts. Prior to installing expansion bolts, the reinforcing bars shall be located with a "rebar locator" supplied by the Tank Constructor. The location of the reinforcing bars shall be marked on the concrete surface indicating the spacing and direction of the bars. Where interference occurs, adjust anchor locations to clear reinforcing bars.

3) Handrail attached to the precast or cast-in-place dome roof shall be installed with stainless steel bolts and thin slab ferrule inserts recommended by the Tank Constructor

G. Ventilator(s)

1) Ventilator(s) shall be installed at locations shown on the Drawings. Ventilators to be installed on a concrete curb with a minimum height of 4-in and a minimum of 6-in wide. The ventilators shall be installed with a watertight gasket and stainless-steel expansion bolts.

H. The "eye lid" ventilators and emergency overflow shall be installed at locations shown on the Drawings. The invert of the ventilators shall be above the design overflow elevation.

I. Wall Manway(s)

1) Manway(s) shall be installed at locations shown on the Drawings.

2) The invert of the manhole shall be 3-ft above the finished grade.

3) The wall manway shall have an aluminum or fiberglass interior ladder to the bottom of the tank and shall have a grab bar installed above the center line of the manway of the same material as the ladder.

J. Liquid Level Indicators

1) Liquid level indicators shall be installed at locations shown on the Drawings.

K. Installation Standards: Install Work according to AWWA D110 standards.

3.02 FIELD QUALITY CONTROL

A. Concrete (Floor and Dome) and Shotcrete (Wall) Testing:

1) Compression test specimens shall be taken during construction from the first placement of each class of concrete specified herein and at intervals thereafter as selected by the Engineer to ensure continued compliance with these Specifications. At least one set of test specimens shall be made for each 50 yards of concrete/shotcrete placed. Each set of test specimens shall be a minimum of 5 cylinders.

2) Compression test specimens for concrete/shotcrete shall conform to ASTM C172/C172M for sampling and ASTM C31/C31M for making and curing test cylinders. Test specimens shall be 6-inch diameter by 12-inch high or 4-inch diameter by 8-inch-high cylinders.

3) Compression test shall be performed in accordance with ASTM C39/C39M. Two test cylinders will be tested at 7 days and two at 28 days. The remaining cylinder will be held to verify test results, if needed.

3.03 FIELD TESTING

A. Test in accordance with AWWA D110.

1) Testing the Completed Tank.

a. Before any backfill is placed, fill tank to the overflow slowly in the presence of the Engineer or Owner’s representative. Observe for visible leaks, any leaks that occur shall be immediately repaired.

b. The maximum allowable leakage after a 48-hour period, in which the entire tank interior surface has been wetted, shall not exceed 0.05 percent of the

tank volume in 24 hours. If the liquid volume loss exceeds this amount, the tank shall be repaired and retested.

3.04 CLEANING AND DISINFECTION

A. If the tank is used for potable water storage the tank shall be disinfected in accordance with AWWA C652, Chlorination Method 2.

B. The Tank Constructor shall provide all labor, material, and facilities required to chlorinate the tank.

C. The chlorine solution shall be applied directly to all surfaces of the tank including the underside of the roof by spray equipment.

END OF SECTION