Composite Water Tank Construction Specifications

Tank Contractor: Phoenix Fabricators and Erectors, LLC

COMPOSITE ELEVATED WATER STORAGE TANK

PART 1.0 – GENERAL SCOPE

1.1 DESCRIPTION OF WORK

A. The work to be performed under this section consists of the furnishing of all materials, tools, equipment, labor and incidentals necessary for the design, manufacture, delivery, erection, painting, disinfection and testing of a composite elevated storage tank. The tank is to be complete with all accessories specified herein, and is to be erected on foundations to be designed and constructed by the Tank Contractor. The tank shall meet all requirements of AWWA D107 Standard for Composite Elevated Water Storage Tank.

B. The contracting company shall own their fabrication facilities. Divided responsibilities between erection and fabrication will not be allowed.

C. A qualified supervisor employed by the Contractor shall be on site at all times during construction of the concrete support structure and water tank.

D. The Contractor shall have completed at least five (5) composite elevated tanks with a minimum capacity of 1,000,000 gallons.

1.2 SUBMITTALS

A. Each bidder shall submit with their proposal a design sketch of the tank and foundation they propose to furnish. The general plan of the structure must show all major dimensions including the tank diameter, the height to low and high water levels, the sizes of all principal and secondary members, thickness of all plates, arrangements of members and size of the tank foundation, including quantities of concrete and rebar.

B. The successful bidder must submit shop drawings for all proposed work to include the tank foundation, concrete support structure, concrete mix design, tank structure showing plate thicknesses, members, details of all connections, special details and member loads, piping, valves, painting and other pertinent information as required per the project plans and specifications. These drawings shall be sealed by a registered Professional Engineer in the State of _____.

PART 2.0 – FOUNDATIONS

2.1 FOUNDATION DESIGN

A. Foundation design shall be based on the recommendations provided in the Geotechnical Report. The Owner shall retain the services of a testing firm to confirm that the design conditions are in conformance with design recommendations. The design of the foundation shall be in accordance with the requirement of ACI 301, 318, and the Geotechnical Report. Minimum concrete compressive strength shall be 3,000 psi at 28 days.

2.2 TANK FOUNDATIONS

A. The Tank Contractor shall furnish and install all materials, labor, and equipment necessary to complete the tank foundation, complete with anchor bolts, reinforcing steel and concrete.

B. The Tank Contractor shall design and prepare construction plans and details for the foundations in accordance with the requirements of the specifications. The foundation construction drawings shall be sealed by a registered Professional Engineer in the State of _____and submitted to the Engineer for review and final approval.

C. All testing of materials concerning the foundations and support structure shall be performed by an independent testing laboratory satisfactory to the Engineer.

PART 3.0 – TANK DESIGN AND MATERIALS

3.1 GOVERNING SPECIFICATIONS

A. Material, design, welding, shop fabrication, erection, testing, and inspection of the proposed elevated water storage tank shall be in compliance with the latest revision of AWWA D107 for “Composite Elevated Tanks for Water Storage” and ACI 318.

B. The composite elevated tank shall consist of the following components: foundation, reinforced concrete support structure and a welded steel water tank. The support structure shall extend vertically from the foundation as a circular concrete wall. A reinforced concrete dome or concrete slab, as detailed by tank manufacturer, shall be provided as structural support for the steel tank within the perimeter of the wall. A reinforced concrete ring beam shall connect the steel tank, concrete dome or slab and concrete support wall. The elevated tank shall be in accordance with the shape, dimensions and details required by these specifications.

C. The following design parameters shall apply, and the structure shall safely withstand the following loads acting separately or in combination:

1. Weight of the structure.
2. Weight of the water in the tank.
3. The structure shall be designed to withstand wind velocities in accordance with AWWA D107.
4. Seismic Design in accordance with AWWA D107.
5. Snow load in accordance with AWWA D107.
6. Minimum thickness of plates in contact with water: ¼ inch.

D. All steel in the structure shall be manufactured, rolled, or shaped in accordance with the current AWWA D107.

3.2 CONCRETE SUPPORT STRUCTURE

A. The concrete support structure shall have a minimum thickness of eight (8) inches exclusive of any architectural relief. The minimum reinforcing steel shall be 0.20% horizontally and 0.15% vertically. The reinforcing steel shall be placed in two layers. A minimum of 0.75% vertical reinforcement shall be provided in the top 6 feet of the wall extending into the concrete ring beam. Minimum concrete cover of interior/exterior faces shall be 1 inch and 1-1/2 inches, respectively.

B. The structural concrete dome or slab tank bottom shall have a minimum thickness of eight (8) inches. A steel dome will not be allowed. Minimum total reinforcement in orthogonal directions shall be 0.40%. The reinforcing steel shall be placed in two layers.

C. The concrete ring beam shall have a nominal width and height of at least two times the support wall thickness. Minimum radial and circumferential reinforcement shall be 0.25%.

D. The effects of openings shall be subjected to an analysis taking into account the stress concentrations and the diminished lateral support that exist in the vicinity of such openings. A minimum of 120% of the reinforcing steel cut by the opening shall be placed around the opening with one half of this amount placed on each side. Openings eight (8) feet wide and greater shall be strengthened by means of an internal buttress located on each side of the opening. The ring beam design shall consider unbalanced forces from the steel tank cone and concrete dome, load conditions varying with water level, eccentricity of loads resulting from design geometry and allowance for variations due to construction imperfections and tolerance. The geometry of the interface shall provide for positive drainage and not allow condensation or precipitation to accumulate at the top of the concrete wall or ring beam.

Design calculations and drawings will be provided, sealed by a registered Professional Engineer in the State of_____.

E. Finishes

1. A smooth form finish in accordance with ACI is required on the outside form surface. This includes patching of tie holes and defects, and removal of fins. Hand rubbing is not required. Patching materials shall be selected to closely match the color of the concrete.

2. A rough form finish in accordance with ACI is required on the inside form surface. This includes patching of tie holes and defects, and removal of fins.

F. Minimum concrete pedestal diameter shall be 24 feet. The pedestal diameter may be increased as required by manufacturer's standard geometry.

3.3 ELEVATED STORAGE TANK

A. Preference shall be given to designs of good appearance with operating characteristics which give a constant pressure on the mains as is consistent with the manufacturer's standards and economics of design.

1. The tank shall have a capacity of _____ gallons.

2. The tank shall have an operating head range of ___ feet between low and high water levels.

3. The high water level (HWL) shall be _____ with an elevation of ___ feet.

3.4 ACCESSORIES

A. Steel Access Tube: A steel pipe 60 inches in diameter located on the vertical centerline of the tank as shown on appended drawings. Access tube shall provide access from the top of the concrete tower to the tank roof. A ladder with safety device shall be provided within the tube.

B. Inlet/Outlet Connection: Provide a __ inch diameter inlet/outlet pipe indicated on the project drawings. Inlet and outlet pipe shall extend from the base of the pedestal to the tank floor elevation. Inlet and outlet pipes shall be stainless steel pipe in the pedestal and carbon steel in the container.

The inlet and outlet pipe shall be designed to support all related static and dynamic loads. Suitable steel brackets, guides and hangers shall be provided on the pedestal and tank floor at a minimum of 20 feet intervals.

The inlet/outlet pipe shall be designed and constructed to accommodate any differential movement caused by settlement and by thermal expansion and contraction over the range of extreme temperature differences expected for the pedestal and pipe.

C. Overflow (AWWA D107-10, Sec. 8.7.5): The overflow shall be a minimum __ inches in diameter, tower-supported stainless steel pipe in the tank pedestal and carbon steel in the container. The overflow pipe shall run vertically beside the central access tube and extend through the tank floor at which point it shall be routed over to the pedestal wall. The overflow shall be brought down to discharge into the junction box indicated on the project drawings. A flap valve will be located at the discharge point to prevent the ingress of birds and insects. The tank manufacturer shall verify that overflow pipe and intake shall have a capacity to handle a _____ gpm fill rate with a maximum water level not more than 6 inches above the top of the weir box.

D. Roof openings (AWWA D107-10, Sec. 8.4.4): Provide two 30 inch diameter weatherproof steel access hatches on the roof of the tank above the high water level. One hatch shall provide egress from the access tube to the roof. The second hatch shall provide access to the interior of the tank near the outer perimeter and the interior painter's rail. The hatches shall have a minimum 6 inch curb and the lid shall overlap the curb 2 inches. Lids to be watertight.

E. Tank Vent (AWWA D107-10, Sec. 8.6.2): The tank vent should be sized for needed venting capacity for maximum inflow or outflow considering a main break at the base of the tank. The overflow pipe shall not be considered a tank vent. The vent will be designed to prevent the ingress of birds, insects, or animals and minimize condensation on the underside of the roof. There should be provisions in the vent design to release differential pressures caused by clogging of the __ mesh non-corrodible vent screen.

   The vent shall be designed to allow the attachment of an exhaust fan for ventilation during painting.

F. Pedestal Vent: Ventilation shall comply with the governing building code requirements, based on occupancy classification. At a minimum, one removable 24 inch X 36 inch vent shall be provided at the top of the pedestal. This vent shall be accessible from the upper platform and may also be designed to provide access to the exterior rigging rails located at the tank/pedestal intersection. Vents shall be accessible from the interior ladders, platforms or floors provided.

G. A 5 foot wide upper platform shall be located at the top of the pedestal to provide access from the pedestal ladder to the roof access ladder located on the interior of the access tube. Platforms shall be provided with handrails,

midrails and toe plates in accordance with OSHA requirements. Grating shall be used for the walking surface.

H. Ladders (AWWA D107-10, Sec. 8.2): Ladders shall be provided from the floor inside the base of the pedestal to the upper platform located below the tank floor. A tank floor manhole shall be provided with ladder access from the upper platform. A ladder shall extend from the upper platform, through the access tube interior, to the roof. Ladder shall be designed in accordance with OSHA standards. Ladders that terminate at platforms or landings shall extend a minimum of 48 inches beyond the platform elevations.

I. Safety Devices (AWWA D107-10, Sec. 8.2.3): All ladders and safety devices shall comply with OSHA Standards. Three climbing belts and clamp assemblies approved by OSHA will be provided.

J. Rigging and Painters' Rails:

1. A minimum 24 inch diameter opening shall be provided at the top of the pedestal. This opening shall be accessible from a platform and shall provide access to the exterior rigging rail located at the tank/pedestal intersection. The access opening may also serve as the pedestal ventilation.

2. A minimum 30 inch diameter opening shall be provided on the tank roof to provide access to the tank interior rigging rails. This access opening may be a combined pressure/vacuum relief mechanism.

K. Tank Floor Manhole: Provide a 30 inch diameter manhole through the tank floor. The manhole shall be operable from a ladder located on the upper platform and shall be designed to withstand the pressure of the tank contents without leakage.

L. Personnel Door: Provide one 36 inch wide X 84 inch high access door. Door frames shall be 16-gauge with concealed reinforcement at hardware locations. Expansion type anchors for existing openings shall be installed near the top, bottom and intermediate point of each jamb to rigidly secure the frame. Doors shall be 1-3/4 inch thick insulated, reinforced, full, flush type with 18-gauge face sheets and concealed reinforcement at hardware locations. All edges shall be finished flush with watertight seams. Shop applied finish for the frame and door shall be baked on rust inhibitive primer. Field finish shall be compatible with the tank exterior. Standard hardware shall be stainless steel and include three 4-1/2 inch hinges, industrial duty closer and lockset. Location of personnel door shall be shown on the drawings.

M. Overhead Vehicle Door: Provide one 10 foot wide X 10 foot high vehicular door. Door installation shall be on the interior face of the support wall. The door frame shall be of steel plate construction, suitably detailed, fastened and

reinforced to accept the door. Operation of the door shall be manual by chain hoist. The curtain shall be formed of 22-gauge steel interlocking slats with end locks and wind locks designed for a wind loading of 20 PSF. Torsion springs shall be mounted on a solid torsion rod, which is attached to an exterior mounted spring tension adjustment wheel. A 24-gauge steel hood shall be provided with a weather seal to protect the assembly. Steel brackets shall be installed to the interior face of the wall with expansion anchors which enclose and support the counterbalance assembly with sealed bearings. Steel curtain guides are mounted to the brackets. The curtain, bottom bar, brackets, guides, hood, pipe, and chain shall be galvanized. A locking device shall be provided. Location of vehicular door shall be shown on the drawings.

N. A tank identification plate shall be mounted on the tank pedestal adjacent to the doorway. The identification plate shall contain the following information:

1. Tank contractor name
2. Year erected
3. Tank capacity in U.S. gallons
4. Tank head range
5. Tank style
6. Contractor's serial number or project number
7. Tank contractor's erection foreman

PART 4.0 – TANK AND SUPPORT STRUCTURE CONSTRUCTION

4.1 ERECTION OF TANK

A. All parts forming the structure shall be built in accordance with approved drawings. Welding procedures and general welding requirements shall be in accordance with AWWA D107, Sections 5.4 and 9.5. Welding shall only be performed by ASME qualified welders. Records of these qualification tests shall be available to the Engineer. The work at all times shall be open to the Engineer or their representative.

B. Upon completion of the tank erection, the Tank Contractor will remove or dispose of all rubbish and other unsightly material caused by its operation, and will leave the premises in good appearance.

4.2 SUPPORT STRUCTURE

A. General

Comply with the minimum requirements of AWWA D107-10, ACI 318 and the applicable requirements of ACI 347, except as modified in this section.

Formwork system design and concrete practice required by this section shall be strictly enforced to ensure concrete is of the highest practicable structural and architectural standards.

Formwork systems shall be designed with the provision of ties and bracing such that concrete components conform to the correct dimensions, shape, alignment and elevation without leakage and mortar and excessive deflection. Formwork systems shall be designed to safely support all loading conditions. Embedded items shall be properly positioned and secured. Form surfaces shall be cleaned of foreign materials and coated with a release agent prior to placing reinforcement.

B. Support Wall

The pedestal wall shall be constructed using a jump form process. The form system shall use curved, prefabricated form segments of the largest practical size to minimize panel joints. Concrete pour height shall be a minimum of 6 feet and a maximum of 12 feet. Form panels shall extend the full height of the concrete pour using only vertical panel joints. Formwork shall be secured using bolts through the wall prior to concrete placement. Panels shall be designed for lateral pressures associated with full height plastic concrete head, and support and bracing shall be provided for construction related impact loads and wind loads. Working platforms shall allow safe access for inspection and concrete placement shall be provided. Form facing material shall be metal, or plywood faced with plastic or fiberglass.

The form system shall incorporate a uniform pattern of vertical and horizontal rustications to provide architectural relief to the exterior wall surface. Construction joints and panel joints shall be located in rustications. Vertical panel joints shall be sealed using closures which combine with the form pattern to prevent grout leakage and panel joint lines. The top of the each concrete placement shall be finished with a grade strip. The vertical and horizontal rustications shall be proportioned and combined to impart a symmetrical architectural pattern to the complete structure. Form ties shall be located so as to impart a uniform patterned effect. No architectural form treatment is required on the interior surface.

Wall forms shall not be disturbed or removed until the concrete has attained sufficient strength such that forming operations and construction loads do not cause surface damage of excessive stress to the sections. The minimum concrete strength shall be established by the Contractor, based on reasonable analysis of foreseeable loads and stresses at critical stages throughout the forming and concrete operations.

Support wall concreting shall incorporate segmented placement procedures. Temporary vertical bulkheads shall divide the wall pour into segments

corresponding to a single batch of concrete. The bulkheads shall be located at rustications, braced rigid and tight to maintain vertical alignment under concrete load without grout leakage. Wall segment concrete shall be placed vertically and continuously to full form height from a single load. Temporary bulkheads shall not be removed until adjacent concrete is placed. Support wall concreting operations shall occur a maximum of once per day. Multiple form movements and concrete placements within a day are not permitted.

Support wall concrete shall utilize a high range water reducer.

Drop chutes or tremies shall be used in walls and columns to prevent free-fall of the concrete over 5 feet and to allow the concrete to be placed through the cage of reinforcing steel. Additionally, the discharge hose from the concrete pump can be lowered in the pour to achieve same. These shall be moved at short intervals to prevent stacking of concrete.

C. Tank Floor

The formwork system for the concrete dome or concrete slab structural floor shall be designed to support all construction loads. Adequate shoring and bracing shall be provided to transfer loads from the pedestal to the ground without appreciable movements. Form surfaces shall be steel, plastic or fiberglass coated materials.

D. Dimensional Tolerances

Variation in thickness:	
Wall	-3.0% to +5.5%
Dome	-6.0% to +10.0%
Support wall variation from plumb:	
In any 5 feet of height	3/8 inch
In any 50 feet of height	1 ½ inches
Maximum in total height	3 inches
Support wall diameter variation	0.4%
Not to exceed	3 inches
Dome floor radius variation	1.0%
Level alignment variation:	
From specified elevation	1 inch
From horizontal plane	½ inch

E. Finishes

Tie holes shall be plugged using grout on the interior and manufactured plugs on the exterior which match the color of the cured concrete as closely as possible.

4.3 TESTING

A. After tank construction has been completed and the tank painted, the tank shall be hydrostatically tested by filling with water which will be furnished by the Owner. Any leaks shall be repaired and the structure made watertight. No repair work will be done on any point unless the water level in the tank is at least two feet below the joint being repaired.

B. In addition, the Tank Contractor shall test the weld joints by means of radiographic testing. All testing shall be done in accordance with the latest revisions of AWWA D107-10, Section 9.5. The radiographic film test results will become the property of the Owner.

PART 5.0 – TEST AND DISINFECTION

A. The structure will be tested by filling the tank with water and any leaks or defects which may appear will be repaired. Prior to acceptance, Contractor shall disinfect the tank in accordance with AWWA C-652 Method 3.

B. After disinfecting the tank and returning the chlorine residual to normal, two bacteriological tests shall be taken 24 hours apart. Both tests must come back non-detectable.

PART 6.0 – SAFETY

A. The Contractor shall strictly comply with all applicable statutes, regulations, orders, rules, requirements and standards of all governmental authorities having jurisdiction with respect to the project, including without limitation, federal, state, and local OSHA and health regulations as well as the latest professional practices.

B. The Contractor shall, at its own expense, protect its employees and other persons from risk of injury, bodily harm, or death arising out of or in any way connected with work preformed.

C. Prior to commencing work, all personnel on the jobsite will have a minimum ten (10) hours of OSHA safety training or equivalent training within the previous year.

PART 7.0 – GUARANTEE

A. The Contractor shall guarantee the structure against any defects in material or workmanship for a period of one (1) year from the date of substantial completion. If any defect is discovered and reported to the Contractor during the guarantee period, the Contractor shall make the necessary repairs without charge to the Owner.