Maximizing Filtered Water Storage at the West Hartford Water Treatment Facility

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The West Hartford Water Treatment Facility (WHWTF), owned and operated by the Metropolitan District Commission (the District), is a slow sand filtration plant that treats an average daily flow of 36 million gallons per day (MGD) and a maximum daily flow of 84 MGD. Source waters from the Barkhamsted and Nepaug Reservoirs flow by gravity via a system of raw water transmission mains to Reservoir No. 5 and the plant's 22 slow sand filters.

The facility began filtering water in 1921, with filtered water mixed in with unfiltered water. Construction of the facility continued and was completed in five stages between 1920 and 1960. The facility serves the Towns of East Hartford, Hartford, Newington, Rocky Hill, West Hartford, and Wethersfield, as well as portions of Farmington, Glastonbury, and Portland.

Following filtration, water is chlorinated, fluoridated, pH adjusted, addition of orthophosphate for corrosion protection, and then stored in two filtered water basins, a 6 MG basin built in 1918 and a 9 MG basin built in 1925. In addition to storage, the basins provide chlorine contact time for disinfection.

In November 2006, Tighe & Bond prepared the Filtered Water Basin Interconnection Study, which evaluated alternatives that would provide additional flexibility to plant operations. The recommendations of the study included the following:

A new 42-inch line (550 linear feet) from the 9 MG basin influent line from Filter Beds 1 through 10 to the 6 MG basin influent line (completed in 2012). This would allow one basin to be taken offline for rehabilitation without reducing total treatment plant output.

Construction of a 2.5 MG wire-wound concrete storage tank northeast of Filter Beds 11 through 14 to provide additional storage for Filter Beds 11 through 18 (to be complete in 2016).

Construction of a 2.5 MG wire-wound concrete storage tank southeast of Filter Bed 5 to provide additional storage for Filter Beds 19 through 22 (to be constructed in a future project).

The new North Water Storage Tank provides additional finished water storage and disinfection time with the use of the internal C-T baffle wall system. The project was divided into two separate contracts, one for site work and site piping, and another for tank construction. The project drawings and specifications were developed by Tighe & Bond coordinating with the District. Since the tank and site preparation would be contracted separately, clear

definition of site preparation requirements was necessary to ensure that the tank construction could proceed efficiently.

The project schedules were established and bids were received in January 2014 for the site preparation work. VMS Construction of Vernon, Connecticut, was the successful bidder and initiated excavation and site work. The excavation work continued throughout 2014 with the final site preparation completed in early 2015. The bids for the separate water storage tank construction contract were received by the District in December 2014. DN Tanks was the successful bidder, and a contract was awarded to DN Tanks in early 2015.

The North Water Storage Tank is a 2.5 million gallon tank designed and constructed in accordance with AWWA Standard D110, Type III, wire-wound prestressed concrete with a free-standing clear-span dome roof. The tank has a diameter of 168 feet with water depth of 15 feet. A key feature of the tank design is the internal C-T baffle wall system, as well as an inlet and outlet pipe diffuser walls. The baffle wall system design was developed by Tighe & Bond, in coordination with DN Tanks, based on the 'Concentric C' configuration to provide a plug-flow type flow pattern within the tank. The system has a baffling factor of 0.6 and provides sufficient time with the disinfectant to meet the required contact time. The baffle wall system is constructed using precast concrete wall panels cast on site.

DN Tanks mobilized onsite in early May 2015 with a construction schedule to complete the project in the late fall. The initial work was to form and reinforce the floor and footings, concurrently with construction of the casting beds for the tank wall and baffle panels. The tank floor was cast as a continuous placement on May 28, starting at 2:30 AM with completion by mid-day. The floor pour required 427 cubic yards of concrete, almost 50 concrete trucks, covering a surface area in excess of 23,200 square feet. There was a single pumper truck setup that pumped concrete to all locations and a single lane construction road to the pumper truck from the concrete staging area. There was a significant amount of logistical coordination to ensure that concrete trucks were properly queued for continuous concrete placement while not having the concrete wait, and also that the concrete finishers were receiving concrete at a an optimal pace. Immediately following the floor construction, the floor was flooded for curing and concrete quality.

AWWA D110, Type III prestressed concrete tanks are constructed of precast concrete panels, cast integrally with an embedded steel diaphragm for water-tightness. The wall panels are cast on site in casting beds surrounding the tank area for ease of erection onto the tank footing. In total, 34 precast primary tank wall panels and 66 precast baffle wall panels were constructed. Each panel weighed in excess of 18,000 pounds.

Given the limitation of work area at the tank construction site, the decision was made to construct the clear-span concrete dome roof as a cast-in-place spherical shell in lieu of the method utilizing precast concrete panels.

Once the floor reached adequate strength, the work began to erect shoring that was used to support the dome construction forming. Concrete tests were completed and results verified for the precast concrete wall panels, and the erecting crane was delivered to the job site. A 275-ton capacity hydraulic crane was used, and panel erection was initiated on June 22. The panel erection process was completed in six days.

After the precast wall and baffle wall panels were erected, the process continued to complete the structural connections between the tank wall panels in preparation for the prestressing process. Concurrently, the dome forming was completed, reinforcing steel placed, and the dome concrete placement was undertaken. The cast-in-place dome was constructed in four sections taking place between August 31 and September 3.

The prestressing operation utilizes high-strength tensile steel wire wrapped helically onto the tank wall in multiple layers, gradually building compressive force placing the core wall in an initial compression of approximately 2,200 psi. Each wire layer is encased in its own layer of shotcrete to provide bonding and corrosion protection. In total, more than 28 miles of prestressing wire were used for the North Water Storage Tank. The prestressing process was completed on October 12, and the finish shotcrete covercoat was applied.

Tank construction was completed on October 19. Once piping connections were made by VMS Construction, the tank was filled to capacity, tested, and approved. The tank will receive the final disinfection process in early spring 2016, at which time the tank will be placed in service.

Once the North Water Storage Tank is placed in service, the District plans to remove the 6 MG basin from service to provide scheduled repairs and upgrades.