

# ENR

Engineering News-Record

# BEST OF THE BEST REGIONAL PROJECTS 2010



**NEW  
YORK  
GIANT**  
Water Treatment  
Plant Blows UV  
Records Away

# New York's Ultraviolet Titan

**World's largest UV water disinfectant plant will more than double the installed capacity in the U.S. when it goes into full operation** By Angelle Bergeron

By April, the power will go on in the \$1.4-billion, 2-billion-gallon-per-day Catskill/Delaware Ultraviolet Disinfection Facility, the world's largest. The plant is being built by the New York City Dept. of Environmental Protection in a county to the north to deliver safe drinking water to the city's nine million residents.

"We are supposed to begin operation in March 2012 and put the entire facility online by May 2012," says Mark Hanson, project director for the Malcolm Pirnie/CH2M Hill joint venture performing \$82 million in construction management services. "On both dates we are about five months ahead of the consent-order schedule, and we have less than 2% change-order costs," he says. "[The project] is on budget, on time and will help nine million people. What could be better than that?"

The New York City facility, which will be funded by water and sewer rates, will treat water from the Cat/Del watershed to meet federal Environmental Protection Agency surface-water-treatment rule requirements. Those requirements dictate that all systems not using filtration install ultraviolet or other specific disinfection methods to inactivate cryptosporidium by April 1, 2012. The EPA granted the city a "filtration avoidance determination" based on the city's long-



standing program to protect its watershed.

NYCDEP has awarded four prime construction contracts on the project. The \$1.1 billion general contractor is SEW, a joint venture of Skanska USA, Whitestone, N.Y.; Ecco III Enterprises Inc., Yonkers, N.Y., and J.F. White Contracting Co., Framingham, Mass.

L.J. Coppola Inc., Thornwood, N.Y., won contracts for both HVAC (\$58.5 million) and plumbing (\$20.5 million). Welsbach Electric Corp., New York City, a subsidiary of EMCOR Group, has a \$107.5-million electrical contract. Malcolm Pirnie, White Plains, N.Y., the water division of ARCADIS-US, is joint-ventured with CH2M Hill, Englewood, Colo., to perform construction management. Hazen and Sawyer, New York City, is joint-ventured with CDM, Cambridge, Mass., on design. Ecco III performed a previous \$54-million site preparation/excavation contract.

"The Skanska joint venture is probably the best-organized contractor I have ever seen," Hanson says, adding that everything about the Cat/Del delivery team—owner, design, contractor and construction manager—is "head and shoulders" above what he has

PHOTO LEFT COURTESY OF WELSBACH ELECTRIC CORP.



seen before. “The firms and individuals are all focused on finishing the job on time,” Hanson says. Working on such a team makes you “plan your work and work your plan,” adds Kenneth Brouwer, vice president of industrial/commercial at Welsbach.

### Size Matters

The project’s complexity is not in its technology or construction processes but in its size, observes Keith Chouinard, Skanska’s vice president of operations. “Everything is supersized at Cat/Del, from the 12-ft-diameter pipe, huge concrete structures, very large crane picks and the 56 UV units,” Chouinard says. “It’s either big in size or quantity. With size comes challenges in managing how everything fits together, coordination with all contractors, engineering and the number of designs.” About 600 workers, at peak, deliver \$20 million in construction per month.

NYC’s water supply system is the largest unfiltered system in the country. It has two watersheds, the Cat/Del and the Croton, that extend 125 miles to the north. They comprise 19 reservoirs and three controlled lakes

and have a total storage capacity of 580 billion gallons, says Thom Hook, business development manager at Malcolm Pirnie. The city gets 95% of its water delivered by gravity through a system of aqueducts, tunnels and streams. “New York City has been purchasing land on a willing buyer/seller basis in the watershed for years in order to control pollutant discharge throughout the watershed,” Hook says.

The Cat/Del watershed supplies 90% of the water; the remainder comes from the Croton watershed. The DEP has a separate, \$2.3-billion water-filtration project under way in the Bronx to filter that.

The Cat/Del UV disinfection facility is being built about two miles downstream from the Kensico Reservoir on the city-owned Eastview site in Westchester County near the towns of Mount Pleasant and Greenburgh. Both the Catskill and Delaware aqueducts travel through the site, which was purchased in the early 1900s as a future water-treatment facility site.

Although UV treatment technology “has a long history” of use for wastewater postdisinfection, “it is relatively new [for it to be] applied to such a large scale for water disinfection,” says Paul Whitener, senior program manager at CH2MHill. That firm was the design-build-operate prime on a 180-mgd-capacity UV water-treatment facility in Seattle that was previously the largest UV treatment facility in the world when it opened in 2004, Whitener says. He says construction of the significantly larger, 2,020-mgd-capacity Cat/Del demonstrates how quickly UV is being adopted. Hanson adds that a 300-mgd UV facility is being planned for Los Angeles.

Total capacity of all UV units supplied in the U.S. through 2008 is less than 1,600 mgd. “The expectation is that Cat/Del will be a catalyst for UV disinfection to be applied to an even greater extent in municipalities across the country,” Whitener says.

To disinfect water, UV photons penetrate cell walls of organisms and are absorbed by the cell’s DNA, blocking replication and infectivity, Hanson explains. UV is extremely effective for inactivating giardia and

### UV GALLERIES

Up to 2 billion gallons of water can pass through the plant’s four UV galleries every day. Welsbach is using 3D CAD to weave the 570,000 ft of conduit and 4.5 million ft of wire required to support the 56,480-volt UV units.

## COVER STORY WATER SUPPLY



cryptosporidium. It does not affect taste, add chemicals or create by-products.

Initially, NYCDEP was planning a filtration facility. “It was about 1998 when it was understood that UV could be effective for drinking water to inactivate cryptosporidium, which is not inactivated by chlorination,” says Richard Peters, vice president at Hazen & Sawyer and project director for the design joint venture with CDM. At that time, the city and EPA began looking at using UV instead of filtration, Peters says. “It’s much more cost-effective and gets at the issue regulatory agencies were concerned about.”

Because no UV disinfection facility had ever been built so large, the design joint venture had to prove UV could be effective on a 2-billion-gallons-per-day flow. “We worked with UV suppliers on concepts for prototype units to get a comfort level that they could manufacture and deliver the applied dose,” Peters says. Water moves through the units at 3 to 4 ft per second, and it must all come within inches of a UV bulb. The Hazen & Sawyer/CDM joint venture put out specifications for design, and units were validated by a third-party consultant at a facility in Johnstown, N.Y.

Trojan Technologies, London, Ontario, Canada, manufactured Cat/Del’s 56, 40-mgd units. Each unit

is 19 ft long, 5.5 ft wide and 7.5 ft tall and is fabricated of stainless steel. Each weighs more than 16,000 lbs and has 210 UV lamps inside, says Mark Peck, Trojan’s corporate project manager. “Trojan has built larger, multiple-chamber systems, but these units are the largest single-chamber systems we have manufactured to date,” Peck says.

### Pushing the Envelope

Design of the structure followed design of the equipment, Peters says. “We came up with a capacity size that was pushing the envelope but also was cost-effective.” For example, many smaller units would have had a larger footprint, and larger units would have meant a larger, costlier building to house them.

Hydraulics posed the next-biggest design challenge, Peters says. Water will come into the site via Shaft 19, a 1940s-constructed shaft that conveys water up to grade from aqueducts 400 to 1,200 ft deep. The flow makes a U-turn to enter the four UV galleries. “Process engineers focused on the UV equipment technology and disinfection, but it was a hydraulic challenge to divide the flow with the heads from two reservoirs, with no pumping and retaining the gravity flow,” Peters says. “We expect the flow to vary from 800 mgd to 1,400 mgd, and the facility is designed [with flaps and valves] to adjust the flow based on demand.”

To power the 480-volt UV units, the design joint venture opted for low-pressure/high-output technology, which requires significantly less electricity at lower operating costs than the alternative, Peters says. The design includes standby generation capacity as backup in the event of the loss of utility power, as well as uninterruptible power supplies—batteries—to maintain uniform power until on-site generation takes over.

“As we say in the business, it’s all pipe and wire, but it’s a matter of getting a lot done in a timely fashion and making sure it’s connected right,” says Welsbach’s Brouwer. By the end of the project, the company will have installed 570,000 ft of galvanized conduit pipe and over 4.5 million ft of wire.

Welsbach created constructibility drawings for the myriad of point-to-point connections, coordinating with LJ Coppola. “This is the first time we’ve coordinated a job in 3D AutoCAD for the layout,” Brouwer says. “It’s an incredible amount of switch gear, coordination and physicality to get it in the time frame.” Welsbach has 100 employees on site.

Divers are working to free up a valve in Shaft 19, 400 ft deep. “The existing drain valve is stuck open at the bottom of the shaft, and we have to either close the valve or put a flange on the valve and fill the pipe connected to it with grout,” Hanson says.



MAP COURTESY OF NYCDEP

## ALL BIG

Skanska had more than 700 critical picks on the project, including this 144-in. Venturi Flow Meter (right) installed in Nov. 2009. Mark Hanson (far right) is construction manager with Malcolm Pirnie and project director for its construction management joint venture with CH2M-Hill.



## Deep Dives

Chouinard says the deep dives require close coordination with DEP and various regulatory agencies. “DEP has invested close to \$160 million in environmental health and safety programs since 2001,” says Michael Saucier, press secretary. “All work within aqueducts and shafts requires detailed work plans that include disinfection of equipment and procedures to ensure that existing structures are protected.”

The forebays that will route water into the UV galleries are still under construction. Concrete work is finishing up, and steel superstructure for bridge cranes is to be completed by mid-summer, Hanson says.

By the end of January SEW will enclose the UV-galleries building, and the focus will move from heavy civil to mechanical, electrical, architectural and inside trades. Keeping the momentum going will be a challenge moving forward with the trades—a time in the process when schedules typically lag, Hanson says, noting, “But so far we’ve been able to do it.”

Chouinard says the use of building information modeling, a safety and health partnership with OSHA, an early partnering agreement by all parties, coordination and communication have contributed to the project’s success. “So far, with 1.4 million man-hours, there have been no financial claims on the project,” Hanson says. As of Nov. 30, SEW reported a lost-time rate of 0.22 for 1.7 million hours. “Until you get perfect, it’s not good enough,” Chouinard says. ■

## CATSKILL DELAWARE UV FACILITY

Untreated water rises in the shaft uptake for the UV units. Then it is distributed to the Catskill Aqueduct or the downtake.

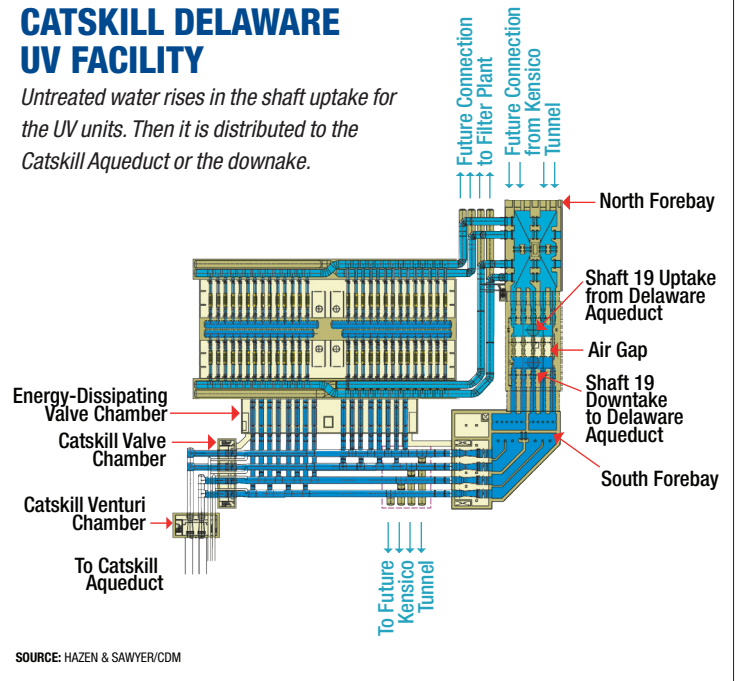


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