



Siemens and Delta Fountains provide automation and control solutions

National September 11 Memorial Fountains at the World Trade Center

For many Americans, the events of September 11, 2001 will remain in their memories forever. It was the day that terrorists hijacked four commercial airliners and flew one into each of the twin 110-story towers of New York's World Trade Center.

To commemorate those who died at the World Trade Center, the National September 11 Memorial & Museum at the World Trade Center Foundation was set up in 2005 to oversee construction of a Memorial on the site of the twin towers. Its scheduled opening is on the 10th anniversary of the tragedy, September 11, 2011.

The foundation opened a worldwide design competition for the Memorial and received more than 5,000 submissions from 63 nations. The winning design, entitled "Reflecting Absence," is an eight-acre plaza with 400 trees that will surround two enormous recessed reflecting pools. Each pool is almost an acre in size and covers the former physical footprint of one of the two towers.

Challenge: How to keep 600,000 gallons of water in each memorial pool flowing and sparkling clear 24x7 through New York City's four seasons

In each of the Memorial's deep reflecting pools, water pours over smooth, stainless steel weirs that stretch horizontally atop the pool's four walls and then falls vertically down into a catch basin to be recirculated. The falling waters provide a soothing acoustic backdrop to the tranquil, reflective surface of the waters in the center of the pool.

When the architects began looking for a manufacturer to help them refine the pools' design, then engineer, build and operate them, only a few U.S. fountain companies were capable of handling a project of this size. When finished, the two pools will be the largest in the world.

They chose Delta Fountains of Jacksonville, Fla., a 22-year-old firm specializing in architectural



Case Study

and floating fountains. The company's portfolio features some of the largest and most spectacular municipal, corporate and private fountains in the nation. But the Memorial project was different from all the others: It would be the company's largest ever.

"We're quite honored to have been selected to help with the design and construction of the Memorial pools," said Delta Fountains President Joe Petry. "

According to Scott Johnston, who co-owns the company with Petry, the Memorial project needed massive plumbing, pumps, filters, water chemistry tanks and precision controls to keep it all running smoothly 24x7 all year round. Their company was also awarded a two-year consulting/monitoring agreement for the pools, and they wanted to be able to monitor all systems from nearly 1,000 miles away at their home base in Jacksonville.

Keeping the water sparkling clean and its acoustic and visual counterpoints consistent minute-to-minute is no small feat, said Johnston. He explained that each pool holds 600,000 gallons of water pumped at a rate of up to 30,000 gallons per minute and filtered at a rate of 6,000 gallons per minute.

"People will be coming to the Memorial from around the world every day of the year any time of day," he said, "so we have to ensure that the reflective and acoustic properties of the pools are the same no matter what the weather or time of day or year."

His partner Petry noted that to help ensure a consistent visitor experience, the weirs, which stretch a quarter mile around the top of the pools' walls, are all mechanically adjustable horizontally and vertically to within a sixteenth of an inch. "This allows us to counter-balance the angle and fall of the water against any expansion in the concrete walls due to a rise or fall in the outdoor temperature."

Despite the project's size, Petry and Johnston knew their company was up to the task. Over the years, they had built a strategic relationship with Siemens, a partner in many prior projects that they trusted to always bring the very best from its portfolio and people to ensure their success.

Their relationship was especially important because one of the challenges facing Delta was the need to select a solution partner with a solid, up-to-date technical solution not only when the project began three years prior, but also one that could be easily upgraded with the latest features and capabilities, so the end solution in 2010 used leading-edge technology. "We called Siemens because we knew they could deliver," both said.

Solution: A comprehensive Siemens Simatic S7-300 programmable controller solution, featuring a G120/CU230P Variable Frequency Drive for Distributed and Remote Control, Plus Redundancy

Siemens brought in its top application engineers from across three of its Industry divisions to work both with its distributor AWC and with Delta Fountains' team to determine specifications and the best hardware and software to meet those needs. The pools' operating complexities required a master control system with a distributed input/output architecture and local slave controls with onboard CPUs for redundancy.

Their ultimate solution? For the master controller, they implemented the Siemens Simatic S7-300 programmable controller that has proven its reliability and performance across a wide range of industries worldwide.

The S7-300 communicates over a Profibus fieldbus network to 16 Simatic ET 200S distributed I/O nodes with integrated CPUs that provide local control for the same number of motorized pumps that



keep each pool's water moving at 30,000 gallons per minute. With its onboard CPU, the ET 200S distributed I/O nodes can offload computing tasks from the S7-300 master controller and permit much faster responses to time-critical signals.

Variable frequency drives (VFDs) were also needed for each pool's pumps, so Delta Fountains could have more precise control over water flow and pressure rates to help maintain the pool water's consistency whether falling over weirs or in the reflective center.

The automation system was modified through the project cycle from a single controller to multiple controllers with two control levels for redundancy. The VFDs changed from MicroMaster 4 technology to the Sinamics G120 VFD units with the CU230-P Control Unit designed specifically for fans and pumps and just released in summer 2010. The solution also provided Siemens motor protection and pilot devices for control and annunciation for each of more than 32 cabinets housing the equipment.

Not only do the 16 G120 VFDs per fountain provide precision flow control; they also dramatically reduce energy consumption. In fact, the Memorial's overall design seeks the Gold certification under the LEED New Construction program of the U.S. Green Building Council.¹

Adaptability and flexibility of the solutions' open architecture is the core technology of Siemens Totally Integrated Automation (TIA), which provided the Delta Fountain engineers with more options in such a massive and complex project with long design and approval cycles. Despite being a fixed-priced project, engineers could make design changes to incorporate new technology while not having a negative financial impact.

With the S7-300 controller, Delta Fountains can also take real-time inputs from sensors just about everywhere in the pools and plumbing that measure temperature, pressure, chemistry, wind and much more, then use the data to automate the controls and keep the water and systems in balance.

Over time, the historical data will build baseline operating profiles according to time of day, month and year, barometric pressure, humidity and a host of other parameters to further automate the pool operations. "There are just so many operating variables," said Petry, "that even with all this sophisticated Siemens automation, we'll initially have to watch everything closely. But over time, these baseline profiles will help anticipate periodic conditions and automatically adjust the parameters as the sensors begin to detect a certain combination of conditions that fit the profile."

The HMI (Human Machine Interface) software used was Siemens Simatic WinCC Flexible on both the main HMI operator station and on each individual Pump VFD panel. All HMI stations provide easy operational visualization of the connected controllers, I/O nodes and VFD devices. With WinCC Flexible, Delta Fountains technicians can operate the pools remotely over the Internet just as if they were onsite from nearly 1,000 miles away in Jacksonville.

¹ World Trade Center Memorial website:
http://www.national911memorial.org/site/PageServer?pagename=New_Memorial_Plaza



Results: Precision control, operating cost-savings, all from nearly 1,000 miles away

Petry and Johnston both agree that without the Siemens solution, their technicians would not have anywhere near the degree of precision control that they do. "For example, the Siemens system can test-sample the water every five seconds and adjust the bromine levels to keep a constant pH," explained Petry.

"Manual sampling, in practical terms, could only sample the water four or five times a day. Even then the readings would not be as precise, nor would the response to an abnormal pH level be as fast."

Petry went on to estimate that the Siemens solution is so comprehensive that it saves the labor of two technicians, or about \$150,000 to \$200,000 a year including benefits. What's more, because day-to-day operations can be controlled remotely from Jacksonville, New York's high living costs can be avoided, too.

The VFDs already mentioned will save considerable energy and CO2 emissions over time, saving costs and the environment. This is because they can drive the 16 pump motors in each pool at optimal speeds all the time. This will also save on motor wear-and-tear, ensuring a sustainable solution while reducing maintenance costs.

The Memorial Plaza's fountains posed many technical challenges. Some of these were more difficult than others, but the Siemens team worked well with our staff to diminish the automation issues," said Petry. "Since we were using some first generation technology, Siemens provided us with some of their top field staff, not only to educate us, but also make us look good in front of our client. We look forward to finishing this and many more projects with this great group of people."



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