Changing Industry, Changing Technology

A Massachusetts company configures water blasting equipment to help return aging power plants to as-designed performance

by Tom Kuennen

In today's brave new era of deregulated electric power generation, utilities that operate the most efficient power plants will make the most money.

The best generating plants are those that use their fuels efficiently, saving cash. More important, they'll squeeze more power out onto the grid at peak demand periods, reaping handsome margins for their owners.

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Tim Hennigan, Jr.

Recognizing this changed generating environment, a Massachusetts-based industrial cleaning contractor has dedicated itself to wringing the highest performance out of its clients' existing power plants.

"Our goal is to restore power plant components to their original design efficiency," said Tim Hennigan, Jr., operations manager of Hennigan Engineering Company, Inc., Hingham, Mass. "We want to return that component to as-new operating condition."

Hennigan Engineering understood how periodic heat exchanger and steam condenser tube fouling affects plant performance. The company then adapted its water blasting hardware to best serve this evolving power plant market. The result is a value-added capability to rejuvenate a fossil or nuclear power plant's performance.

Hydrolasing

Hennigan Engineering "hydrolases" power plant components. It uses extensive, balance-sheet-oriented marketing materials to sell new customers on the advantages of Hydrolasing instead of mechanical scrubbing.

That's not as easy as it sounds, because some power plants still operate from the pre-deregulation mindset. Hennigan provides mechanical cleaning too; in fact, many Hydrolasing customers are those he has "sold up" to the value-added service.

"Our company provides different methods of condenser and heat exchanger cleaning," Tim says. "We offer the entire gamut of component cleaning, from chemical to mechanical to Hydrolasing."

But neither low-tech mechanical scrubbing nor water blasting with inferior nozzles and accessories will bring inner piping surfaces to 100 percent cleanliness. One hundred percent clean is not only possible: "We prove it on a daily basis for our clients," says Tim. "Ninety-five percent of the system components we work on are restored to 100 percent design-level efficiency."

Cleanliness is verified through post-cleaning analysis. "Performance engineering tests our work through factors such as cooling water temperature in/out and condenser back pressure," says Tim. "Dozens of calculations can be used to test condenser and heat exchanger cleanliness and heat transfer efficiency."

'Hydrolasing' is Hennigan's term for its value-added industrial cleaning service using high-pressure water.

Deregulation changes the game

Hard mineral scale is the enemy of power plant efficiency, and it can cost big dollars. "Today, for plants running 800 to 1,100 megawatts, the net revenue can be more than a million dollars per day," says Tim. "If efficiency is off by a few percentage points because of heat exchanger or condenser scaling, they literally can lose millions of dollars a year in revenue."

Deregulation — leading to market competition based on the price of power — has made efficiency more important than ever. At fossil-fuel power plants, high pressure water jets can be used for anything from cleaning boilers to scouring condensers and heat exchangers. "There's a direct impact on fossil fuel costs," says Tim. "With a cleaner component tube inner diameter, you will produce more power for the same burned fuel."

In nuclear plants, clean components maximize the output of electricity sent out on transmission lines. Producing incrementally more power can significantly increase revenue, especially during peak usage periods, when market prices rise.

Deregulation also has changed the nature of scheduled plant outages. Nuclear plant refueling outages used to

A technician for Hennigan Engineering Hydrolases one of 75,000 fifty-foot-long, 0.875-inch-diameter titanium condenser tubes at Indian Point Three nuclear power plant, Buchanan, N.Y.

P R O F I L E

Hennigan Engineering Company, Inc., Hingham, Mass.

FOUNDED:	**1967**
SPECIALTIES:	**Condenser and heat exchanger tube cleaning, pipe and tank cleaning, surface prep and coating removal, hydrodemolition and waterjet cutting**
WATER JET UNITS:	**10 water jet cleaners (7 units with UNx pumps and fluid heads from Jetstream of Houston LLC, 10,000 to 40,000 psi)**
OTHER EQUIPMENT:	**Surface preparation and hydrodemolition robots, Welch Allyn borescope inspection system with articulating head, push camera, self-propelled robotic crawler cameras**
WEB SITE:	**www.henniganengineering.com**

Exploring New Markets

While Hennigan Engineering's core business is serving the commercial power generation industry from Massachusetts to Oregon, it continues to look at new markets.

"We're finding an increased demand in the construction industry for high-pressure water jetting equipment and services, particularly in the concrete construction market," says Tim Hennigan, Jr., operations manager.

Boston's Big Dig project, for example, is providing opportunities with its immersed precast tube tunnel construction for the 1-90 Mass Pike extension project. Tunnel sections are precast and assembled, then floated from dry dock to the tunnel site and sunk 60 to 90 feet below sea level.

"The platform below for the tunnel has to be perfectly stable and level," Tim says. "We were called to develop a high-pressure water jetting system to remove concrete overpours from the platform that will accept the tunnel segments. We were to be waterjetting underwater, using commercial divers working in zero visibility."

Hennigan started with a single high-pressure waterjet pump, 300 to 400 hp, with a single, zero-thrust gun. "We found that's the only moderately effective way to go," Tim says. "You're dividing the flow of the water front and back, so it doesn't push the underwater diver all over the ocean floor. But when you divide 20 or 30 gpm in half, you're talking 10 to 15 gallons of water that's being directed per minute, so the effectiveness is cut in half."

In answer, Hennigan developed a technique that ties multiple pumps together and has been able to put a zero-thrust gun underwater with a total of 800 hp, at 20,000 psi, run by one man. "It's zero thrust, but delivering a tremendous amount of horsepower, and it will cut concrete like butter."

A diver with Hennigan Engineering Hydrolasing equipment by Jetstream of Houston descends into Boston Harbor to remove concrete overpours on a tunnel foundation, as part of Boston's "Big Dig" Central Artery/Tunnel project. (Photo courtesy of Boston Globe)

last as long as 60 to 120 days, but in today's competitive arena, outages are tightly planned and much shorter. For example, Tim reports that the Entergy Nuclear Northeast's Indian Point Three power plant at Buchanan, N.Y., schedules its refueling and maintenance outage for 25 days.

Changes for contractors

Utility deregulation and competition also have changed the way Hennigan Engineering wins contracts. "In a deregulated environment, competition is everything," Tim says. "In the past, if they wanted us to do a job, systems engineering or maintenance management could write a sole-source justification. But in the deregulated environment, we will be one of at least three bidders vying for the job."

But there is an upside. "The interest in squeezing every last drop of revenue from a particular power plant has become significant," Tim says "Maintenance engineering and performance and chemistry departments have become acutely aware of the need to maximize performance."

Indian Point Three has seen the advantages of the hydrolase process over mechanical methods. Hennigan used to have a contract for mechanically cleaning Indian Point Three's heat exchanger and condenser tube bundles, but the results were unsatisfactory.

The plant draws cooling water from the Hudson River. "The river water has a very high silt factor, and there are a lot of organic and inorganic materials in the water that tend to plate out on the tube I.D.s," says Tim. "It's a light biological fouling material infused with river silt. You end up with a thin layer of mud and silt that's plated out with a biological lattice that holds it all together."

"When you're looking at projects that run two 12-hour shifts, seven days a week, with 12 to 40 people on any given job, if we're down for any length of time, it's not only costly to our client, but to us. If there's any kind of issue with the pumping system, we can have it opened up, torn down, rebuilt, and back in service literally in minutes."

Tim Hennigan, Jr.

Hennigan Engineering technicians enter a condenser at the Indian Point Three nuclear power plant.

Mechanical brush cleaning removed the larger obstructions, but not the thin layer of biological film, which had a dramatic effect on the heat exchange of the tube. The biological substrate also provided a base to which additional silt would adhere.

Making the case

Tim made the case for Hydrolasing in meetings with plant staff. "Twice-yearly mechanical brushing was just keeping the plant at satisfactory performance levels," he says. "But at the last outage, in 1999, engineering decided to permit high-pressure waterjet cleaning."

Mechanical brushing of the 75,000, 50-foot-long, 0.875-inch titanium tubes took six days. However, the lengthier and more expensive Hydrolasing technique has paid off. "Instead of multiple mechanical cleaning efforts during the plant's 18-month operating cycle, only one hydrolase cleaning is necessary," Tim says. "The process actually makes the plant money by maximizing condenser performance and power output and minimizing downtime required for mid-cycle mechanical tube cleaning."

Hennigan's patent-pending nozzle designs ensure 100 percent tube cleaning. Off-the-shelf nozzles are less costly. Some are geared toward the petrochemical market, designed to remove bulk volume fouling or to clear blockages from heat exchangers, condensers or piping. But they do not get pipe interiors 100 percent clean.

By contrast, Hennigan has optimized a series of nozzle designs targeting specific fouling media, from river silt and biological film, to the hardest mineral scale. Nozzle design aside, many factors influence the ability of hydrolase gear to produce superior results, says Tim. These include flow rate, nozzle pressure, nozzle traverse speed, system pressure controls,

Hennigan Engineering's nitrogen gas pressure regulator provides full positive shut-off control, bypassing unused water from a work area at Indian Point Three nuclear power plant.

and friction-induced pressure drop.

"Knowing how to manipulate these factors — along with employing the optimum nozzle design for the given application —is how we turn theory into results for our clients," Tim explains.

One platform

When working at a power plant that generates revenue in excess of a million dollars a day, a contractor can ill-afford to delay restart. To preclude this possibility, Hennigan has optimized its system, from training, to accessories, to the heart of the pumping system. The company standardized on a core platform of waterblasting equipment, choosing the UNx fluid end configuration from Jetstream of Houston.

"We made that decision to minimize service interruptions," says Tim. "In our line of work, after safety, one of the key things we address is schedule compliance. As a large percentage of our work is power plant-outage-based, we have limited, critical windows of opportunity to complete our projects. We need to know exactly how long it's going to take to set up our system, get our crew in position, complete the service, and break down and move on."

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And that's why the serviceability of the Jetstream UNx fluid end is important, Tim says. "Because our systems are under so much stress at all times, we anticipate that they will require a certain amount of onsite maintenance," he says "And we've found that the UNx fluid end is extremely user friendly when it comes to onsite maintenance and repair."

In 90 percent of anticipated pumping system maintenance, personnel can get the fluid end off in five minutes or less. "When you're looking at projects that run two 12-hour shifts, seven days a week, with 12 to 40 people on any given job, if we're down for any length of time, it's not only costly to our client, but to us," Tim says. "If there's any kind of issue with the pumping system, we can have it opened up, torn down, rebuilt, and back in service literally in minutes."

Nitrogen regulating system

Other unique and unconventional components figure into Hennigan's water jetting gear. "We run a specialized pressure regulating system that uses a nitrogen gas pressure regulator, with full positive shut off controls," Tim says.

This is in contrast to conventional dump-style jetting components, in which excess flow from the tool when unused is diverted into the work area. "Our gear is 100 percent full positive shut off, so when the operator is not using the tool, the water is bypassed at the pressure regulator outside of the plant," Tim says.

"Our main reason is that we perform a lot of in-containment work in radiologically controlled areas of power plants, and the last thing you want is for non-working water to enter a radiologically controlled area. It then has to be treated as a radiological waste, that can become very costly. Our system guarantees that every drop of water that enters the plant is being used on the task, and not wasted."

Innovative technology built around Hydrolasing has helped Hennigan Engineering to stake out a profitable niche in the waterjet cleaning industry. ■