



Hempstead Resource Recovery Facility, Hempstead, N.Y.

Owner/operator: American Ref-Fuel Co.

Although this 72-MW waste-to-energy facility is the smallest of this year's Top Plants, its wealth of innovative design features makes it deserving of the recognition. Seven days a week, Hempstead turns thousands of tons of useless—and costly to dispose of—municipal solid waste into thousands of valuable megawatt-hours. By doing so, the plant plays a key role in fostering public environmental awareness.

By Ken Wicker

The Hempstead Resource Recovery Facility (Figure 1) in Hempstead, Long Island, has been converting municipal solid waste (MSW) to electricity for 16 years now, under a 20-year power purchase agreement with the Long Island Power Authority (LIPA). Owned and operated by Montvale, N.J.-based American Ref-Fuel Co. LLC (itself indirectly owned by affiliates of Credit Suisse First Boston Private Equity and American International Group Inc.), the plant has an impressive track record. Since 1989, Hempstead, which is permitted to process 914,325 tons of MSW annually, has sold an average of 548,000 MWh per year.

According to Steve Bossotti, plant manager, "We currently receive up to 4,500 tons of waste per day that would otherwise be shipped out of state, most likely to a landfill. Our neighbors very much appreciate how we contribute to the local electricity supply in an environmentally responsible manner."

Indeed, the operation of the Hempstead plant represents a classic win-win situation for the town of Hempstead, nearby towns, and all of Long Island. In exchange for paying the plant to take MSW off its hands, Hempstead gets electricity—an expensive commodity in short supply during summers on "the Island"—at preferred rates. What's more, the Hempstead plant is as environmentally sound as it is economically beneficial. Two years ago, American Ref-Fuel enrolled it in the U.S. EPA's Performance Track program, in part to ensure that the plant will become even cleaner and leaner. To remain a participant in the program, Hempstead's owner/operator committed to making the following four improvements:

- Increase its steam cycle efficiency by 2%.
- Annually reduce its output of hazardous waste by 350 pounds and its output of waste water by 130,000 gallons.

Earlier this year, the EPA recognized the Hempstead facility as one of the "best of the best" by granting the plant its 2004 Performance Track Outreach Award for its efforts to spread the word about the program and encourage others to participate in it. As a result, three flags (Figure 2) now fly outside the entrance to the plant: Old Glory, one symbolizing Hempstead's participation in the EPA program, and one celebrating the plant's elite "Star" status in the Occupational Safety and Health Administration's (OSHA's) Voluntary



1. Fuel's gold. The 72-MW Hempstead Resource Recovery Facility on Long Island, N.Y., is powered by municipal solid waste. *Courtesy: American Ref-Fuel Co.*



2. Pennant race. Flags bearing OSHA's Voluntary Protection Program Star and the EPA Performance Track logo fly in front of the Hempstead facility in tribute to the plant's safety and environmental records. *Courtesy: American Ref-Fuel Co.*

- Reduce the plant's annual well water usage by 5.5 million gallons.

Protection Program. Last year, when OSHA recertified Hempstead as a star safety performer for the second time, the agency singled out the plant's safety action item database, computerized safety permit system, and job training program as particularly praiseworthy.

Talking trash

Hempstead is no run-of-the-mill waste-to-energy (WTE) facility. What distinguishes its combustion technology—from Deutsche Babcock Anlagen (Oberhausen, Germany)—is that all combustible materials are burned as they are received. Unlike the process at refuse-derived fuel facilities, no special preparation or mixing procedures are required at the front end. The only preprocessing done at Hempstead removes impermissible and unburnable materials (via a "throw-down" inspection procedure), which are then disposed of in the plant's refuse bunker.

Another unique design feature of the Hempstead facility is its wet/dry cooling tower. Its plume can be—and is—abated, with negligible effect on the plant's efficiency, whenever atmospheric conditions are such that the vapor emitted by the cooling tower might become fog or ice. A third distinction of the plant is its use of a bypass condenser, which enables the plant's boilers to run even if the main turbine-generator or main condenser is down. A fourth notable feature is a reserve transformer through which the plant can import and export some power if the main switchyard were to be taken out of service for an emergency or scheduled maintenance.

Finally, Hempstead is one of only a few WTE plants in the U.S. equipped with a reverse-air baghouse with a shaker system (Figure 3). Each boiler train is outfitted with 12 modules, each consisting of 88 bags that are 34 feet long and 12

inches in diameter. The filter medium—Teflon-coated fiberglass—works from the inside out. Each bag is fitted with seven anti-collapse rings and is suspended from shaker support bars at the top of the module by adjustable-tension springs.

The baghouse is cleaned by reversing the flue gas through the bags or by operating the shaker system under abnormal differential pressure conditions. In addition, sonic horns have been installed in about half of the baghouse cells to improve the effectiveness of the cleaning process. According to Bossotti, "The horns are easier on the fabric of the bags, and that should help extend their life." He adds that Hempstead has been exploring the use of membrane materials other than Teflon-coated fiberglass, with the goal of lowering the baghouse's pressure drop without compromising its performance. "Preliminary stack test results appear quite favorable," Bossotti says.

Plant layout

Like most resource recovery facilities, Hempstead has five major systems dedicated to:

- Waste handling.
- Combustion and energy recovery.
- Environmental control.
- Residue handling/metal recovery.
- Balance of plant equipment.

Hempstead's waste handling system comprises the plant's refuse bunker, cranes, feed chutes, and the equipment on the tipping floor. The plant's weigh scales and roadway system can handle up to 70 garbage trucks per hour. Hempstead, which normally receives waste six days a week, 18 hours a day, can take in more than 300 tons of waste per hour. The refuse bunker has a capacity of more than 70,000

cubic yards—a volume sufficient to hold up to 18,000 tons of waste (depending on the level of compaction).

Environmental control begins as incoming trucks pass over the weigh scales. Radiation monitors scan each truck and compare its reading to the background radiation level; if a truck triggers an alarm, it is stopped from entering the tipping bay and quarantined. After a truck is cleared and dumps its waste on the tipping floor, attendants and crane operators visually screen the cargo for unacceptable and incom-bustible materials and segregate them for proper disposal.

Hempstead's combustion and energy recovery system consists of a ram feeder, roller grates, a three-pass boiler, and an economizer—all designed by Deutsche Babcock Anlagen. As the waste burns, the boiler produces steam that is fed into a turbine-generator (from ABB Asea Brown Boveri Ltd.) rated at 88 MVA (Figure 4). Burning the MSW reduces its volume by 90% and its weight by 80%.

According to Bossotti, "Despite the variable and unpredictable nature of our fuel, precise temperature control enables us to run the plant in steady-state mode and with minimal environmental impact." Hempstead's boiler is equipped with four packaged, oil-fired burners from Ray Burner Co. (Richmond, Calif.). One pair, with a total output of 63 million Btu/hr, is always available to ensure that the temperature inside the furnace never falls below the minimum of 1,500F required by the New York State Department of Environmental Conservation (NYSDEC). The other pair, rated at 19.8 million Btu/hr, is used to ignite the MSW at start-up and to provide backup temperature control.

At Hempstead, the oil used to fire the Ray burners is the facility's only fuel



3. In the bag. A rare (for a U.S. waste-to-energy facility) reverse-air baghouse with a shaker system helps minimize Hempstead's air emissions. *Courtesy: American Ref-Fuel Co.*



4. European flavor. Hempstead's 88-MVA turbine-generator from Switzerland's ABB Asea Brown Boveri Ltd. is powered by steam from a three-pass boiler and economizer designed by Germany's Deutsche Babcock Anlagen. *Courtesy: American Ref-Fuel Co.*

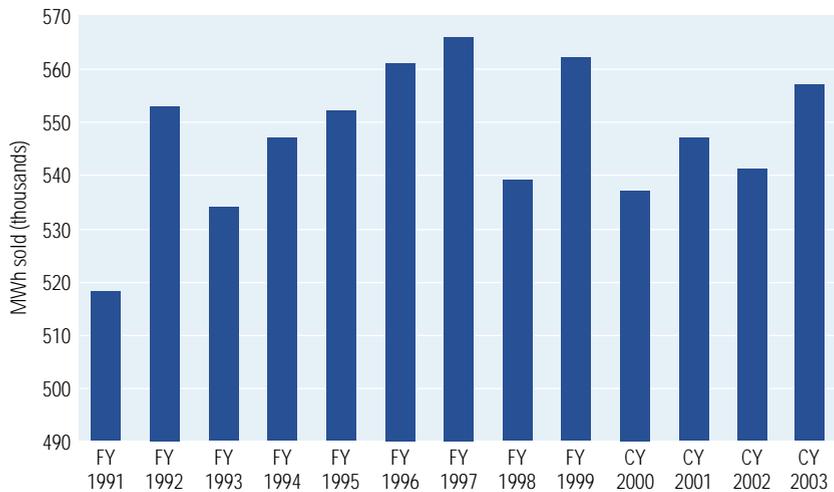
that isn't free. Accordingly, management is constantly seeking to reduce its consumption. One recent project with that goal upgraded the combustion system's controls to reduce the deviation of steam flow to within 3% of its setpoint. Says Bossotti, "[The change] reduced our need to co-fire oil for temperature control by 15% and optimized the baseload-ing of the turbine-generator as well. The less we pay for oil, the more profitable we are."

Typical of a modern WTE facility, Hempstead uses a state-of-the-art air pollution control system to ensure that the facility meets or exceeds all combustion emissions requirements of the NYSDEC, including maximum achievable control technology (MACT) standards. The system has the following components:

- A dry scrubber, which removes acid gases (including HCl and SO₂).
- A fabric filter baghouse, which removes the fine particulate matter generated during MSW combustion.
- A precyclone separator, which also removes particulate matter and reduces dust loads on the dry scrubber and fabric filter.
- A NO_x-control system based on urea injection.
- A continuous emissions monitoring system, which tracks the plant's output of pollutants such as CO, SO₂, and NO_x on a 24/7 basis. It also keeps tabs on operating parameters such as stack opacity, furnace temperature, steam flow, and baghouse inlet temperature—all of which have permitted limits at Hempstead.

All WTE facilities need to be able to deal with metals at the back end of the plant. Hempstead's residue handling/metal recovery system does so by separating ferrous and nonferrous metals from the plant's residue stream for recycling, leaving the remaining ash for disposal. All of the ash from the boilers is routed through the system too. The facility recycles about 2.5% of its annual waste throughput as ferrous metals (more than 20,000 tons) by reselling them in the scrap market, thus adding to the plant's bottom line. In 1999 plant management decided to extract nonferrous metals—including aluminum, copper, and brass—from the ash stream as well. Last year, the eddy-current separator system installed for that purpose recycled more than 1,000 tons of nonferrous metals, representing about 0.1% of the waste stream.

5. Trash to cash. Net power sold is a clear measure of the Hempstead facility's success. Not only has it averaged more than 548,000 MWh per year, but it also set a calendar year record in 2003 with 557,460 MWh sold. *Source: American Ref-Fuel Co.*



Community relations

Bossotti says that because most of Hempstead's staff live nearby, "It behooves us to play a positive role in the community, including doing what we can to encourage recycling." Being a good neighbor, he adds, also includes making all reasonable efforts to minimize emission upsets, noise, odors, litter, and truck traffic on local roads. For community feedback on the plant's performance, Bossotti and Scott Wheeler, Hempstead's environmental engineer, meet with the town of Hempstead's Solid Waste Advisory Committee and commissioner of sanitation every six weeks. During the session, the two men provide the public officials with a plant status report, preview any upcoming projects, and address any plant-related issues that citizens may have raised.

The Hempstead WTE plant plays an important role in the town's integrated approach to MSW management. The town, which has adopted New York State's hierarchical philosophy of "recycle, compost, incinerate, landfill," views the Hempstead facility as playing a key role in its environmental efforts. To that end, the town provides weekly curbside collection of paper and cardboard products and metal, plastic, and glass containers, and the program has paid off with recycling rates that are consistently above 30%. In addition to collecting normal household waste, the town also collects yard waste separately and designates days for residents to put out hazardous waste. Town leaders understand

that keeping such incombustible waste from reaching the Hempstead facility is the best way to minimize its airborne emissions.

Success, by the numbers

Since its start-up 16 years ago, the Hempstead WTE facility has been one of the best-performing in the industry, and it continues to set production records. Bossotti calls the plant's excellent performance "the result of good design, operations, and management practices." Among the monthly plant records set recently are these: 85,879 tons of MSW processed, 522,928,000 lb of steam generated, and 50,959 MWh sold in a month (to LIPA). Last year—its fourth-best year ever—Hempstead generated 557,459 MWh (Figure 5).

Naturally, the Hempstead plant's continuing success would not be possible without a staff of dedicated and qualified employees. One reason why OSHA praised Hempstead's job training program last year was that it instills in every new hire the importance of regulatory compliance. Another was that every one of those new hires gets to spend some time with Scott Wheeler prior to assuming his or her duties in the plant. According to Wheeler, "All of our personnel—regardless of their position—are involved in and committed to achieving the plant's environmental goals. Environmental awareness is a condition of employment for all employees, and their on-the-job environmental performance is a big factor in their performance evaluations." ■