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Leak Detection Program Results in MW Increase

By Teresa Hansen, Associate Editor

The Miami-Dade County Resources Recovery Facility has been turning trash into energy for more than 25 years. Although the owner retrofitted the plant three times in those 25 years, much of the equipment is original. Suspecting that aging equipment could be diminishing the plant's efficiency, the plant's project engineer initiated a leak detection and repair program, ultimately resulting in a 1 MW increase in power output.

The Miami-Dade County Resources Recovery Facility is a 4,200-ton per day combined waste-to-energy and waste-processing plant operated by the Montenay Power Corp. The facility processes one-third of the 3.5 million tons of waste generated each year by the residents and businesses in the greater Miami-Dade County, Fla., area. It generates 75 MW of electricity.

The first retrofit, in 1989, involved changing the waste processing system from a wet to a dry process. This left the facility steam-limited because the new boilers had lower steam flow and temperature ratings than the original boilers. The second retrofit, in 1997, involved upgrading the trash processing system to allow commercial and wood waste, including yard waste, to be processed into a biomass fuel and a high-grade soil for recycling. This second retrofit boosted the facility's processing capabilities to more than 1.2 million tons per year, making it the largest in the world. The third retrofit, in 2000, involved complying with the Clean Air Act Amendments (CAAA) of 1990 and meeting more stringent air emission limits. In all retrofits, the original turbine, condenser, feedwater heaters and cooling tower were left unchanged. The rating for each of the plant's four boilers is 180,000 lb/hr steam flow at 625 psia and 721 F. The turbine cycle contains two modules, each consisting of a three-extraction steam turbine, the condenser, a steam jet air ejector set, a gland steam condenser, a low-pressure condensate heater, an open deaerator, a high-pressure feedwater heater and a steam driven boiler feed pump turbine.

Conco crew supervisor Wayne Holt sprays helium around valves and piping within the vacuum boundary.

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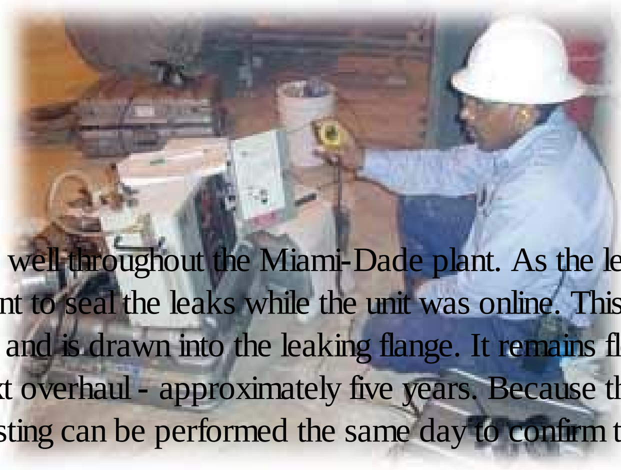
Dominic Marra, the facility's project engineer, was concerned that because of the facility's age, much of the equipment could be leaking, causing a costly loss in total power output. He contacted Conco Systems Inc., Verona, Pa., the firm that provided tube-cleaning services for the plant's condenser. Conco's Leak Detection Division, Gaithersburg, Md., pioneered the techniques for using helium and sulfur hexafluoride (SF_6) tracer gases to leak test condensers and ancillary equipment in power plants.

Turbine backpressure is a key parameter in steam-to-power efficiency. Using available performance correction curves, Conco employees developed a simplified approximation to correlate the power loss attributed to running high backpressures. The design backpressure for the unit at Miami-Dade is 1.227 psia or 27.4 inches Hg vacuum. Due to air in-leakage, extra steam loading on the condenser from leaking valves, and cooling tower inefficiencies, the plant was running at approximately 1.9 psia. This pressure varied slightly from summer to winter. The higher backpressure accounted for 1 MW power loss per turbine - 2 MW total.

Venting equipment must be installed on a steam condenser to prevent non-condensable gases from accumulating in the vapor space. If allowed to accumulate, even small amounts of non-condensable gases inhibit heat transfer and adversely affect unit performance by increasing backpressure. Large amounts can virtually block the condensation process. Although some of these gases are released from solution and some arrive with the exhaust steam, the major non-condensable component is air. Most plants use steam jet air ejectors or vacuum pumps for evacuating the non-condensable gases.

Although precautions are taken to make the system vacuum-tight, leaks do happen. Most of the air finds its way into the sub-atmospheric condenser system as leakage. Older methods for trying to identify vacuum air in-leakage sources include spraying shaving cream, or similar substances, around flanges and valve stems. In recent years, Conco's tracer gas testing has been more widely accepted as a method to help identify air in-leakage sources. Conco sprays the tracer gases, such as helium or SF_6, intermittently around everything within the vacuum boundary while using a mass spectrometer or fluorotracer analyzer to detect low concentrations of the gas at the outlet of the extractor. Helium is normally sufficient to identify leaks, but SF_6 is used if higher sensitivity is required. Once the helium is detected, areas are re-sprayed to confirm the leak source. The time it takes for the helium to be detected, the number of divisions on the scale of the mass spectrometer and the time it takes to clear the monitor, all indicate the severity of the leak.



Jackie Lewis, a Montenay operator, observes the mass spectrometer and checks the response time (the time from the release of the gas and its detection) for an identified leak.

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Helium tracer gas testing worked well throughout the Miami-Dade plant. As the leaks were identified, the Conco crew used a special flexible sealant to seal the leaks while the unit was online. This sealant is specially formulated for the purpose of sealing in-leakage and is drawn into the leaking flange. It remains flexible through several thermal cycles, normally lasting to the next overhaul - approximately five years. Because the leaks are sealed as soon as they are identified, subsequent testing can be performed the same day to confirm that the leaks are, indeed, sealed.

Leak detection at Miami-Dade has resulted in nearly a 1 MW increase in power output for each unit - 2 MW total. According to Marra, leak detection and sealing, along with condenser cleaning, have become part of the facility's regular maintenance procedures to optimize its efficiency.

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