Case Study

Eight AERCO Benchmarks Heat a 1.1M Square Foot Glass Office Complex

Customer	**RexCorp Plaza**
Location	**Long Island, NY**
Industry	**Industrial**
AERCO Product Installed	**Benchmark 2.0***

What the Client Needed

Long Island is known for having some of the highest electricity prices in the United States. For a decade and a half, the 1.1M sq. ft. RexCorp Plaza, the largest building structure on Long Island, was heated by way of an electric space heating plant.

Year after year, the stifling energy costs put a substantial drag on the building's bottom line. Consequently, building owners undertook a massive project in 1999 to switch their electric heating plant to a more affordable, natural gas-fired alternative. The project presented engineers with a variety of difficult challenges:

- To heat a 1.1M sq. ft. glass office building from a mechanical room measuring only 30 ft. long by 24 ft. wide by 10 ft. high
- The need to support a cold water hydronic heating loop with a temperature differential of greater than 60ºF
- The need to safely accommodate exhaust gases in a small basement mechanical room and eliminate noticeable smoke plumes escaping from external vents
- The need to integrate with the building's existing Building Management System

AERCO's Solution

"We were presented with a unique situation," said Eric Ettinger, president of Ettinger Associates. "the owners didn't want to abandon their electrical heating plant investment. Instead they chose to establish a gas-powered plant elsewhere on the premises. The gas-powered plant would serve as the primary heating system, with the electric structure functioning as a backup. Although there would be two independent power plants, the gas-fired boiler plant would need to support the building's existing hydronic loop to minimize project costs." This situation presented engineers with several challenges; challenges that eight AERCO Benchmark Units were uniquely equipped to meet:

- Heating a 1.1M sq. ft. glass office building from a mechanical room measuring only 30 ft. long by 24 ft. wide by 10 ft. high
- Finding space for a second mechanical room in a fully occupied building was almost impossible. The best RexCorp Plaza could provide was a small room in the basement. Engineers needed to fit enough equipment into the room to heat the entire building and decided to design the system using a high temperature differential (ΔT) of 62ºF to increase the output that could be produced by a small heating plant.
- The system utilized eight 2.0M BTU/hr. gas-fired AERCO Benchmark boilers. The Benchmark was chosen because it fit the parameters of both the size of the room and the type of system into which it would be

*This case study references a previously available version of the Benchmark boiler.

integrated. Not only is the Benchmark space-efficient - each stainless steel unit fits through a 30-inch doorway and occupies a footprint of 12 sq. ft. with zero side-wall clearance - but it is also designed to run efficiently in systems utilizing high ΔTs.

- "Because the Benchmark plant took up so little space, plenty of room was left for the boiler exhaust system and its unique air economizer that were integral to RexCorp's new space heating system," said Ettinger. "The eight Benchmarks, both size-wise and design-wise, were a perfect fit."
- The need to support a low temperature hydronic heating loop with a temperature differential of greater than 60ºF
- Because of Benchmark's condensing capabilities, the low hot water temperature of the hydronic loop was an asset that enabled the AERCO boiler plant to operate more efficiently. Not only did the equipment fit the system, it did so in a way that would increase fuel savings and lower operating costs.
- "Our existing electric boilers had no problem handling low temperatures," said Ettinger. "But in the absence of gas-fired combustion there is no opportunity to condense. This opportunity to reclaim energy that would otherwise be lost in the combustion process added a new dimension to the efficiency and cost effectiveness that the right gas-fired plant could deliver."
- The Benchmark's combustion chamber and heat exchanger are constructed specifically to operate in condensing mode. Condensing within the heat exchanger increases efficiency by as much as 12% - by turning more of the boiler's fuel into usable heat. The process occurs naturally when the water vapor, created as a by-product of the combustion process, cools below its dew point (≈135ºF) as a result of exposure to cooler return water temperatures, which are typically around 100ºF. Approximately 1,000 BTUs of heat are released for every pound of water vapor that is converted to liquid. The Benchmark boiler's ability to accept low-return water temperatures fit perfectly into EAB Plaza's heating loop - where temperatures ranged from 105ºF to 42ºF.
- However, as the latent heat is extracted from the water vapor, an acid condensate remains on the surface of the heat exchanger. While this acid can severely damage most boilers, the Benchmark units are constructed with the highest quality materials and are designed to drain freely. As a result, RexCorp reaps the economic benefit of the condensing operations without worrying about durability and longevity. Had engineers selected non-condensing gas-fired equipment, not only would RexCorp be forced to forgo the added fuel savings, a primary objective of the project, they would have to invest in boiler pumps, three-way valves and heat exchangers that would needlessly complicate the system and take up more room in an already limited heating plant space.
- Because of the simplicity of the Benchmark's design, and its independence from complicated external pumps and heat exchangers, the new gas-fired plant integrated smoothly into RexCorp Plaza's existing heating loop without major modifications to the system itself.
- The need to safely accommodate exhaust gases in a small basement mechanical room and to eliminate visible smoke plumes escaping from external vents
- With the introduction of a gas-fired heating plant, RexCorp Plaza suddenly had venting to contend with, which was especially challenging due to the complex's all-glass design. A dark smoke plume would have been an unacceptable eyesore; the Ettinger team had to engineer a solution that would produce no visible plume.
- To solve this problem the engineers installed an air economizer which filtered out the waste that would travel up the flue, thus eliminating the thick smoke. The positive pressure/natural draft design of the Benchmark supported breach venting of all eight boilers to the single, shared air economizer and up a single flue. "The standard flue for a boiler plant of this type would be 48 inches," said Ettinger. "The AERCO plant utilized a passageway that was less than half that size."
- While the overall switch from electric to gas promised inherent savings to the building owners, the Benchmark plant has helped to alleviate the financial burden even more with its unsurpassed modulating ability. Using technology proven in the field for more than 15 years, the Benchmark's patented combustion control precisely matches supply to real-time demand. With 20:1 turndown, each 2.0M BTU/hour unit can support a mere 100,000 BTU load (5% of total capacity) before cycling off. From there, boiler

output increases in precise 1% increments to prevent temperature overshoot. Besides using less fuel by reducing wasteful on/off cycling and eliminating overshoot typical of conventional gas-fired equipment, the Benchmark units actually run more efficiently in part-load situations. At low fire, the 2.0M BTU/hour design capacity of the heat exchanger becomes greatly "oversized," promoting greater energy transfer and cooler exhaust gases.

Return on Investment

"Beyond simply switching our fuel source from electric to natural gas, the project that started as a series of challenges to overcome culminated in an outstanding example of a high-efficiency space heating design," said Ettinger. "This glass building has weathered some cold winters since we finished the retrofit, and the AERCO units have performed their jobs brilliantly. Even the simplicity of their design has been a plus. The design basically consists of a blower, an air fuel valve and a heat exchanger. Not much can go wrong with them, and because of this, maintenance has not extended beyond the routine."

As for the electric plant, even though it has been kept in operation, it has proved an untapped asset. "Since the completion of the properly sized gas-fired plant, the energy demand of the massive structure has never exceeded the supply provided by those eight AERCO Benchmark boilers," added Ettinger. "Not a single electric unit has switched on."

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