

Case study

McCormack Building

Boston, Massachusetts



Hybrid chiller plant increases cooling capacity, decreases utility costs more than \$500,000 annually

At a time when energy budgets are growing because of rising utility costs, the Commonwealth of Massachusetts is fighting the trend by requiring a 10 percent reduction in operating costs in government buildings, including energy and maintenance costs. An immediate resolution for the McCormack building, one of the Commonwealth's four Boston properties, was to cut HVAC-energy usage. Through the addition of a hybrid chiller plant, including a mix of gas-drive absorption chillers and electric-drive centrifugal chillers, the Commonwealth will take advantage of less expensive gas rates (especially in summer) to efficiently and economically condition the 22-story, 660,000 square-foot building.

The 22-story McCormack Building is home to 2,200 employees who work for a number of state agencies.

Rising cooling load and electric demand

Built in 1975, the McCormack Building's chiller plant was originally designed with steam-drive, absorption chillers. Purchased steam drove the chillers, and provided space heat and domestic hot water to the building.

In the mid-1980s, as part of an energy-savings program, the absorption chillers were replaced with two, 450-TR, electric-drive centrifugal chillers. A 450-TR, variable speed-drive chiller was added in the late 1990s to meet rising load requirements. However, an inadequate supply of electricity meant just two of these three chillers went online.

"The electrical system was originally designed to support a building designed for a steam-absorption system," explained Bijan Mohammadipour, principal engineer with the Bureau of State Office Buildings. "The capacity of the electrical system was less than it would have been had the building been designed for electric-drive chillers. So, the addition of electric-drive chillers, plus the additional demands for electricity created by the explosion of office automation, soon exceeded the supply of electricity to the building."

"Since then, the cost of electricity has increased, as has the cost of steam, all at a time when our operating budget was cut and the building cooling load was increasing from 1200 TR to 1850 TR," he continued. "We needed to come up with a method that allowed us to reduce our energy costs without compromising the comfort level in the building."

 **YORK**[®]
BY JOHNSON CONTROLS



The YORK gas-drive chillers, manufactured by Johnson Controls, were selected because the units can meet more than 40 percent of the building's cooling load without increasing the demand on the building's electrical service, and the chillers can take advantage of lower gas rates during the cooling season.

A plan is developed

Working closely with other divisions within the Commonwealth and a consulting engineering firm, a practical and affordable plan was developed.

Following the plan's recommendations, the Commonwealth removed the two 450-TR, electric-drive centrifugal chillers installed as part of the 1980s renovation. They then moved two electric-drive centrifugal chillers, 550-TR and 650-TR, from the adjacent Saltonstall Building into the McCormack Building. Finally, they installed two YORK 400-TR, gas-drive, absorption chiller-heaters, manufactured by Johnson Controls, in the new hybrid plant. The newer 450-TR centrifugal chiller installed during the late 1990s renovation remained in place as an emergency back-up chiller.

Semoon Oh, president of VAV International, Inc., a full-service, consulting-engineering firm, designed the new mechanical system. "We selected gas-drive chillers for a number of reasons," Oh stated. "First of all, they function as the lead chillers, able to meet more than 40 percent of the building's cooling load without increasing the demand on the building's electrical service. Second, they take advantage of lower gas rates during the cooling season, when electric rates are typically much higher, reducing energy costs and the dependency on electricity." (The electric chillers supplement the gas-drive chillers to meet load requirements, and also run at night and during off-peak hours to take advantage of lower electricity rates.)

"Finally," added Oh, "the YORK chiller-heaters offer back-up heating capability to the building's gas-fired heating system, in case of emergency."

Experience indicates big savings to come

According to preliminary studies conducted by Mohammadipour, the move to a hybrid plant will save the Commonwealth approximately \$530,000 annually in utility costs. That figure increases when you add manpower savings that are associated with newer, more-efficient equipment.

Previous experience enables Mohammadipour make this prediction. In the early 1990s, he recommended the replacement of the steam-absorption system at the state's Hurley Building in downtown Boston, with two new YORK gas-drive absorption chillers reducing the annual maintenance contract on the system 40 percent.

At the McCormack Building, the cooling capacity in the building increased by 1200 TR, while the electrical demand decreased by 300 kW. Said Mohammadipour, "The benefit of a true hybrid system is that we can run our electric chillers on hot nights, when cooling requirements and electricity rates are lower, to keep the building cool. During the daytime, when electricity costs are higher, we start with the gas-drive chillers, and only add the electric chillers as necessary."

In addition to these savings, NSTAR and Keyspan (the local electric company and gas company) provided more than \$250,000 in energy-conservation rebates. Together, the savings and rebates have enabled Mohammadipour and his team to easily meet the Commonwealth's directive.

"Ten years ago, we decided to take a chance with gas-drive chillers at the Hurley Building. The technology was relatively new, and we had no experience with a hybrid plant. Fortunately, we met with success, and now we are duplicating that success in the McCormack Building, taking advantage of two different energy sources while increasing our cooling capacity.

