Hartford Plaza

Chicago, Illinois

Chicago High-Rise Property Selects Hybrid Plant for Chiller Replacement

Hartford Office Plaza property at 100 and 150 South Wacker Drive in Chicago was recently the site of a chiller plant makeover that provides energy source flexibility, enhanced tenant comfort, reduced operating costs, and capacity to accommodate the unique HVAC requirements of modern tenants. The property was recently acquired by a partnership of Lincoln Property Company and Carlyle Realty. In acquiring the property, Lincoln/Carlyle recognized that the opportunity to retrofit the existing plant would have a positive impact on their investment.

The property consists of two high-rise buildings — the 31-story Building 150 tower built in 1970 and the 21-story Building 100 tower built in 1960. An underground concourse and mechanical floor connect both buildings. Since the purchase in 1999, Lincoln Property Company has managed the facility. Immediately following the purchase, the owners and manager evaluated options for updating the aging chiller plants serving the buildings.

The Building 150 chiller plant consisted of two 30-year-old 1,000-ton single-stage steam absorption chillers. Building 100 had two 40-year-old 1,000-ton two-stage centrifugal chillers. Both chiller plants were considered to be in poor condition

Combination chiller plant improves negotiating position with energy suppliers.

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and not reliable for continued use. In addition, they were very inefficient when compared to modern chiller equipment. The centrifugal machines used R-11 refrigerant.

Owners Weighed Alternatives

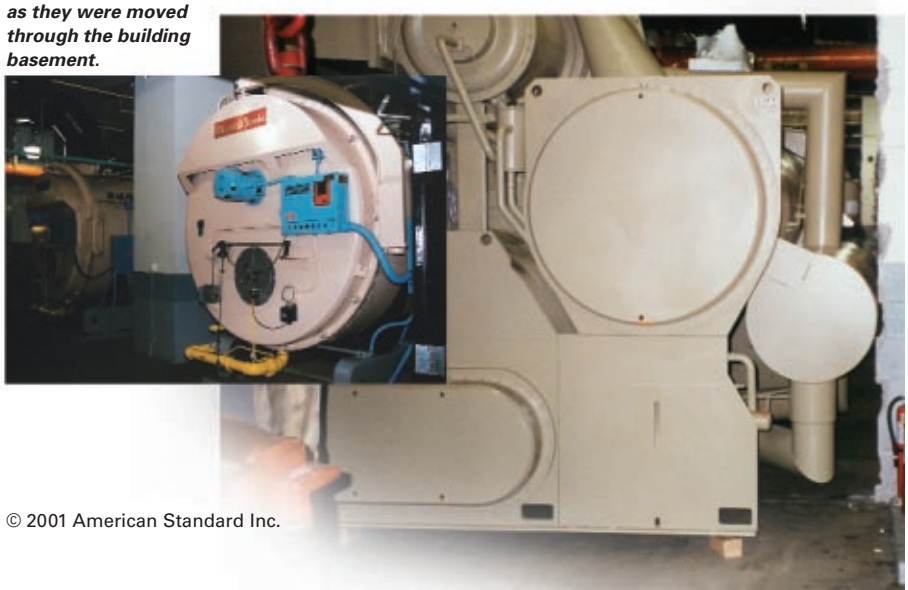
The owners considered the alternatives to either receive chilled water service from Exelon Thermal Energy, the local district cooling company, or to upgrade the chiller plant. The company decided in December 1999 to upgrade the plant. The project was put on a fast track because the upgraded plant needed to be back running at full capacity by May 15, 2000. Lincoln Property Company worked with the Trane Chicago commercial sales office to order equipment on an accelerated schedule and to arrange installation and startup.

The design for the replacement chiller plant took advantage of the fact that the three existing Cleaver-Brooks steam boilers in Building 150 were in very good condition. Both buildings had permits for condenser cooling water intake and discharge from the adjacent Chicago River. Where the two buildings had previously operated their chiller plants independently, the new plan called for a common chiller plant to be located in the Building 150 sub-basement mechanical room consuming a less-than-permitted amount of Building 150 river water.

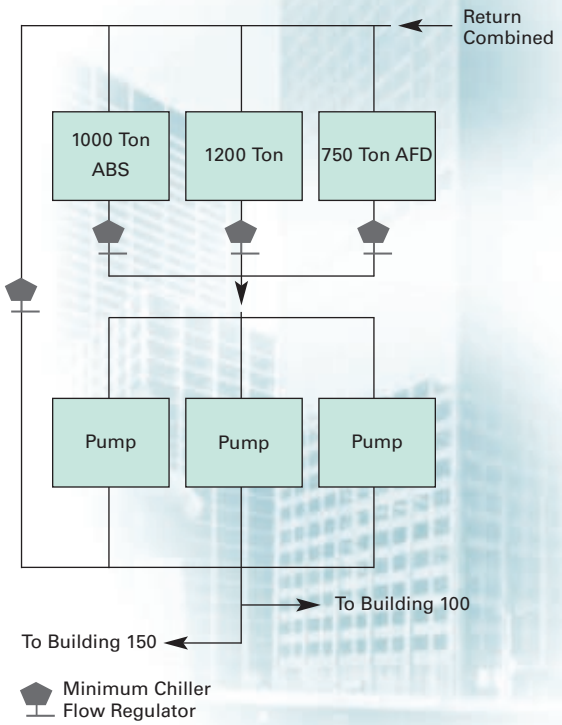
The replacement chiller plant consists of two centrifugal chillers and a single-stage absorption chiller operating in parallel on a common chilled water header. The electric centrifugal chillers are 1,250-ton and 750-ton Trane CenTraVac™ Model CVHF multistage units. These machines operate on refrigerant R-123. The 750-ton machine is equipped with an Adaptive Frequency™ drive to allow it to handle low-level cooling loads during the winter and shoulder months. These chillers would have efficiencies around .55 kW/ton at standard tower water temperatures. But, with the lower water temperatures typically available from river water, actual efficiencies have been as low as .37 kW/ton.

To take advantage of the existing boilers, the plant also includes a new Trane single-stage absorption machine rated at 1,000 tons. Chiller plant centralization required steam, condenser water, and chilled water lines to be routed to the new chillers with new electric power. Steam to the absorption machine is delivered at 12 psig from gas boilers. The electric service to the centrifugal machines is at 480V.

Below: Original boilers provide steam for absorption chiller.
Below right: Chillers had very tight clearances as they were moved through the building basement.



Variable Speed Pumps Draw-Thru Chiller



Top: Trane single-stage absorption chiller. Above: Plant is controlled and units prioritized using the Trane Tracer Summit system.

Packaged pump system features variable speed chilled water and condensate pumps.

Trane CenTraVac centrifugal chiller.

River Water Cooling Opportunity

All three chillers take advantage of existing permits to use the Chicago River for condenser cooling. The condenser water goes through a strainer and deposition of material on the chiller tube walls is regularly monitored. Currently it appears that condenser tubes will need to be cleaned twice a season. The design for the new chiller plant takes extensive advantage of variable speed drives for both chilled water and condenser (river) water.

According to Lincoln Property's general building manager, Tim Incerto, one goal of the project was to be able to match building cooling load economically at a wide range of levels. "Our new system gives a lot of flexibility," Incerto notes. "Some days you only need one of the machines." During warmer summer days, either the large electric unit or the absorption unit is base loaded and the other units subsequently brought on line, based on comparative energy costs. An added benefit is Lincoln's ability to provide chilled water 24/7 to technology tenants.

The new plant features Systecon packaged variable speed Variprime™ chilled water pumps. The variable speed feature allows the plant to be optimized as a whole, depending on condenser water temperatures and cooling demand. Depending on the economic decision of the building chief engineer, Norm De Sousa, the variable speed chilled water pumps are actually used to bias the system toward the electric chillers or the absorption machine, with the chillers following load requirements. The Trane UCP2™ unit control panel makes this close load-following characteristic possible.

Energy Source Decision Daily

"Typically, Norm makes the economic decision daily on how to load the chillers," says Incerto. The electric supplier to the building is ComEd, a division of Exelon Enterprises. At the present time, the electric demand charge is $12.81 per kW from October to May and $16.41 from June through September. The demand charge is based on the three highest electric peaks of the month. Possible chiller plant contributions to the demand charge influence the decision on which chiller to base load, especially in the summer.

The natural gas delivery is through Peoples Energy of Chicago and gas supplies are purchased by negotiated contract from various producers. The availability of favorably priced contract gas, particularly in the summer months, also influences decisions on which units to dispatch first. According to Incerto, "There's no doubt that this combination

Units were lowered through an opening cut in the plaza deck, above the basement.

"The idea to go with a hybrid plant was clearly a winner …"

chiller plant improves our negotiating position with energy suppliers. We have a more attractive load profile to both the gas and electric suppliers."

Demanding Schedule and Challenging Location

The tight schedule and the location of the project in downtown Chicago, near The Loop, created special challenges. Incerto says, "A lot of people were amazed that we were able to get it done on schedule." Bill Denton from the Trane Chicago commercial sales office was involved not only in the system design, but also in arranging delivery, rigging, and installation of the equipment. "This was a demanding project in terms of delivery schedule and equipment clearances," notes Denton. "We worked with the factory to meet the delivery schedule."

The mechanical contractor was Competitive Piping Systems of Chicago and the rigging contractor was Taft Construction of Chicago. The chillers and assembled pump packages were delivered with oversize and special-use street permits on Friday and Sunday nights of February 25 and 27. A 300-ton boom crane was used to lift the equipment off the flatbed trucks through an opening in the plaza floor, and to lower it two offset levels to the mechanical room where it was rolled and lifted into place. "In places the clearances were just inches or less," remarks Denton. "It was very tight!" The chillers did not need to be disassembled to fit into the remodeled spaces.

Building Comfort Improved Immediately

With the installation of the new plant before the summer of 2000, the chilled water temperature dropped from 48°F to 42°F, giving tenants better comfort and more effective dehumidification. Denton emphasizes that the primary goal of the project was tenant comfort. However system efficiency was an important driver as well. "The efficiency benefit and the energy choice flexibility improved value for the building owners."

Incerto notes that the decision to use the hybrid plant approach was influenced by the good condition of the existing boilers and the opportunity to take advantage of the seasonal and daily variations in energy costs. Reflecting on the decision, Incerto notes, "The idea to go with a hybrid plant was clearly a winner, especially given the uncertainty of today's utility market. This solution gives us energy choices that other downtown buildings don't enjoy."

An unanticipated bonus was freed mechanical space created by centralizing the plant. Lincoln/Carlyle has since used the spare space to install tenant specific systems.

Summarizing the project results, Incerto emphasizes, "We obviously focused on the numbers and looked at it from an economic payback and equipment design standpoint. A new, efficient chiller plant translates into higher net rents and improved tenant comfort."

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