Gas Air Conditioning Creates Flexibility

Gives Building Operators a Choice

AT A GLANCE

- Energy price issues reduced with hybrid cooling systems
- Absorption cooling a time-tested solution
- Engine drives offer reliability, heat recovery option
- Steam turbines ideal in situations with surplus steam capacity

Engine and chiller units can be separated to simplify rigging and installation. This makes them practical for chiller retrofit projects.

Uncertainty about future energy prices is a recurring theme in discussions with operators of commercial buildings. For many, that concern is most prominent in the selection of a building cooling system. Electricity prices, including demand charges, have risen dramatically in recent years. In many cases, increases are most dramatic during the summer months, when the cooling plant will be used the most.

Electric Energy Supplies are Tight

Future electric energy costs are difficult to forecast, but in many regions, supplies are tight. New base-load electric generation is expensive to build and operate. Prices can be expected to rise, in some places quite dramatically.

Owners are discovering the merits of installing redundant cooling capacity powered by another energy source — natural gas. This approach offers flexibility: the building operator can decide from day to day, or even hourly, which energy source is preferable. Often the times of the year when electric prices are highest coincide with lower prices for natural gas.

Various Types of Gas Cooling

Several technologies use natural gas for space cooling. One of the oldest is the absorption chiller, which uses a water/lithium bromide solution as the refrigerant and a thermal source — steam, hot water, or a direct burner flame — as the driver. The steam or hot water can be generated by a modern boiler, or can even be a thermal byproduct of an on-site electric generation plant. Major manufacturers of large absorption chillers include York, Trane, Carrier, Broad and Thermax.

Chicago High-Rise Goes Hybrid

This was the approach taken at the Hartford Plaza office building in Chicago. The property consists of two high-rise buildings. In recent years, the 30-year-old chiller plant for the two buildings was replaced. The owners, Lincoln Property Group and Carlyle Realty, chose to install two new Trane electric centrifugal chillers totaling 2,000 tons and a 1,000-ton Trane single-stage absorption chiller.

The chillers are operated on a common chilled water header and can operate in any combination. A part of the attraction for the absorption chiller was that it could use the facility's Cleaver Brooks steam boilers, which were in very good condition.

Absorption Chiller Provides Operator a Choice

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

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ADDITIONAL INFORMATION ALSO AVAILABLE AT:
www.gasairconditioning.org and at
www.energysolutionscenter.org

A recent State of California office building project used three 400-ton TECOCHILL engine chiller units by Tecogen to provide energy source diversity, as well as serving as a source for building hot water.

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.

In addition to the large-scale absorption chillers, smaller water-ammonia cycle absorption units are available from manufacturers such as Robur, which offers 4 & 5 ton units, and unit packages totaling up to 25 tons. These are well suited to residential and light commercial applications, and can operate either as standalone units or in combination with conventional electric refrigeration systems.

Engine Drives Also an Option

Another approach to using natural gas as an energy source is engine driven chillers. Today's natural gas-fired reciprocating engines have become highly reliable and many building operators are choosing this approach. For example, York offers a natural gas-fired packaged engine-driven chiller that features a Caterpillar engine and a York centrifugal chiller in sizes from 350 to 1800 tons. These systems have COPs as high as 1.9 at ARI conditions, and even higher at part load or with heat recovery options employed.

Another important provider is Tecogen, with TECOCHILL™ engine-driven products ranging in size from 50 to 1,000 tons. This product was recently installed in a state building project in California. The state, mindful of past problems with electric power shortages, requires cooling plants in its new state government buildings to be capable of operating on more than one energy source. So when state engineers wrote the specifications for a new, four-building project called the California Capitol East End, they chose a hybrid utility plant that combines natural gas cooling with a conventional electric air conditioning system

The TECOCHILL system selected can provide cooling even in the event of electricity brownouts. "They did not want to rely solely on electricity to provide cooling," says Benjamin Sun, Vice-President of Flack & Kurtz San Francisco, the engineers of record for mechanical and electrical systems in the California Capitol East End project. All three water-cooled TECOCHILLs, rated at 400 tons each, run year-round. In addition to cooling the computer room, heat from the TECOCHILL engine jackets is sent through a heat exchanger to provide domestic hot water and supplementary wintertime space heating at no additional cost.

Summer days in Sacramento can reach 105°F, with an average summer high of 95°F. Average winter temperatures range from a high of 53°F to a low of 37°F. The state energy code requires a cooling plant to offer energy recovery, or to operate using a renewable energy source. "We were able to meet that code requirement by using the hybrid plant," Sun says.

Hot Water a System Bonus

Thus another attractive feature of engine driven chillers is their ability to provide hot water from engine waste heat. For buildings that need hot water for any purpose, this adds to the already-attractive operating economy of such systems. The engine heat is extracted from the engine coolant, exhaust and from the lubricating oil.

A slightly different approach is used by the Trane Gas Powered Chiller (GPC), which features a Waukesha engine generator set coupled with an electric-drive centrifugal chiller. The GPC chiller unit can be operated either by the engine or through a conventional central-station electric source. Thus the owner has the option of operating the chiller using either energy source.

Steam Turbines Keep Arena Cool

In addition to a wide range of absorption chillers, York offers steam-turbine drive centrifugal chillers. These are attractive for large commercial operations that have an economical steam supply, such as from central plant steam boilers. Such a system was recently installed in the arena at the University of Maryland in College Park — The Comcast Center.

The $125 million basketball arena has now been in use for several years, hosting University athletic programs. Among the 470,000-square foot arena's many innovative design features is a 2,100-ton chiller plant with one electric drive centrifugal chiller and one steam-turbine drive centrifugal chiller. Each chiller uses R-134a refrigerant and each is sized at 1,050 tons. "The ability to use electricity or steam gives me the flexibility I need to manage energy costs. I can change the operating parameters of my chillers based on my real energy costs," noted John I. Vucci, the University's Assistant Director–HVAC Systems.

Avoiding Summer Electric Charges

All of these alternative methods of creating chilled water use minimal or no central station electric power, making them ideal for locations with high summer electric rates or demand charges. They are highly useful elements of a hybrid chiller plant design that will give the operator the opportunity to select the appropriate fuel source.

Further, the redundant capacity is reassuring from a maintenance standpoint and allows for facility growth. The fact that they can start up and run with a low electric energy demand makes them ideal for locations where there are potential blackouts or service curtailments. It may be that a hybrid chiller plant is part of your future.