Components of a Comprehensive Chiller Replacement Analysis: How to Make Replacement Easy

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In March's column, Mark Harbin, Compliance Information Services Manager with Environmental Support Solutions discussed what to consider before deciding to convert, retrofit or replace any chiller model. This month, he looks at how to streamline the replacement process to make it as cost effective and easy as possible.

After presenting all the conversion, retrofit or replacement options available, the owner of your company has made the decision to replace a chiller. The next stage in your investigation should be a chiller replacement analysis.

Components of a comprehensive chiller replacement analysis:

1. *Overall system condition.* Inspect the electrical system including starters, conductors, main feeds and conduits. Cooling towers, pumps, and air handlers should be checked to see if they will need to be replaced or rebuilt. Vibration analysis can reveal potential bearing and balance problems. Piping, valves and fittings must be checked for integrity to avoid surprises. Use ASHRAE Standard 15 mechanical room design considerations as part of any professional recommendation.

2. *System characteristics.* Cooling requirements, load conditions and times are important issues to investigate. For example, a facility that needs 500 tons at peak load, but for only 30 days out of the year, and the rest of the year needs only 250 tons, will appreciate a recommendation for a chiller that performs well in the 50 percent range.

   Knowing which energy sources a chiller uses, or could potentially use, can help curb energy costs. A facility with excess steam generation capacity might consider a turbine-driven centrifugal chiller or an absorption chiller. A hybrid central plant using electricity and gas to power chillers can curtail high demand charges and potential service outages.

3. *Budget considerations.* Some owners may want to phase in chiller replacement projects due to budget constraints. In this situation, contractors could suggest owners investigate three potential energy saving options:

   - Lease purchase or "guarantee" options that help fund a complete project.
   - Incentives and energy grants offered by utilities or the Federal Department of Energy.
   - Combining a chiller project with other projects, such as lighting system modernization. This strategy sometimes can improve energy savings, and the likelihood that the project will be approved by management.

4. *Equipment availability and lead-times.* In recent years, demand for the new generation of chillers has doubled the average lead-time. To help reduce the wait time for your chiller, consider seasonal stocking programs offered by manufacturers.

5. *Energy efficiency measures.* Be sure to get performance ratings on all chiller selections and quotes. Less efficient chillers are inexpensive, but sometimes a more expensive chiller can deliver the extra energy savings that can win approval for a project. Part-load ratings are better than full load ratings as an indicator of a chiller's energy efficiency throughout its entire operating range.

Chiller technology alternatives

The recent emergence of new, high efficiency chillers is unprecedented in the history of the industry. Owners of CFC chillers are faced with a bewildering array of choices when they decide to consider replacement. In many cases it is up to the contractor to help the owner review and analyze the alternatives.

Two main energy sources are available for running chillers: electricity and natural gas — this includes steam and waste heat.

Electric chillers include centrifugal, screw, reciprocating and scroll compressors.

1. Electric centrifugals have moderate space requirements and noise levels. They range in capacity from 150 to 2000 tons for standard production units. Nearly 80 percent of chillers in the Untied States weigh less than 500 tons. This technology has the most flexibility in refrigerant usage including R-22, R-134a, and R-123. Efficiency ratings of less than .50 kW/ton are now quite common. Variable speed drives also can increase the part load efficiency into the .2 kW/ton range.

2. Screw , also known as rotary, technology recently crossed over from the industrial refrigeration sector to the comfort cooling sector. Like centrifugals, they don't require much space in a mechanical room, but their noise profiles are significantly higher than centrifugals. This presents a challenge for replacement projects where the chiller location is close to occupied spaces. Sound attenuation shrouds, vibration isolators, or additional chiller room insulation may be required to avoid potential noise complaints. Tonnage ranges and efficiencies are similar to centrifugals, however they cannot utilize variable speed drives, so the lowest kW/ton ratings usually don't get below the .40 threshold. Refrigerants that can be used include R-22, R-134a, and most recently R-410a.

3. Reciprocating technology, which has been around since the beginning of commercial refrigeration, is most noted for its rugged design and ability to be rebuilt in the field, but less so for its energy efficiency. Space requirements are minimal, and noise and vibration levels are medium to high. Their capacity roughly ranges from 50 to 450 tons and their overall efficiency is a relatively unspectacular .80 kW/ton.

4. Scroll technology is rapidly overtaking the niche of reciprocating chillers in comfort cooling. They provide small size, low noise and vibration, and good efficiency. Available in air-cooled and water cooled configurations, scroll chiller capacity can reach approximately 65 tons, which makes them good candidates for spot cooling or make-up cooling applications. For example, a facility that loses 150 tons of cooling capacity after it converts its chillers may want to consider adding a couple of small scroll chillers to make up the difference.

Gas chillers include direct and indirect fired absorbers, and gas engine-driven centrifugals.

1. Absorption chillers have fairly large space requirements and very low noise profiles. Direct-fired units can use natural gas and fuel oil as energy sources. Indirect-fired units can be powered with high- or low-pressure steam and hot water. In fact, some facilities use waste heated water to run absorbers. Tonnage for these units can range from 150 to 1,500 tons. Most impressive is that they use water as a refrigerant. Their efficiency ranges from a 1.2 to 1.8 coefficient of performance depending on heat input and water flows. This technology is useful where electricity and demand rates are high, and where it is less susceptible to service faults or outages.

2. Natural gas engine-driven centrifugal chillers are somewhat new to the scene. They are big and relatively noisy, even with sound attenuation. They tout very high energy efficiency with a coefficient of performance of up to 2.0 when used in conjunction with a heat recovery option. Refrigerants that can be used in these systems include R-22 and R-134a. Their tonnage ranges from 150 to 1,200 tons. Maintenance costs of natural gas engine-driven centrifugal chillers can be relatively high due to the fact that there is a combustion engine that needs periodic tune-ups and overhauls in addition to normal centrifugal chiller maintenance.

Environmental Support Solutions (Environ.com), Tempe, Ariz. provides compliance software, training and consulting to organizations affected by refrigerant, indoor air quality, waste, and health & safety issues. For more information e-mail Environ.com at info@environ.com, call them at 1-800-289-6116 ext. 1 or visit their compliance information center Web site at www.environ.com.