CFC replacement: Winning the game

With Du Pont’s announcement it will cease production of CFC refrigerants a year earlier than the law requires, you may be wondering what to do about your chillers. Replace them? Retrofit them? Try to manage the CFCs in them? Here are some ideas to guide you.

replacement strategy may be anything but simple. Fortunately, though, with the right information and a clear understanding of the situation, managers and engineers can confidently make prudent replacement decisions that represent long-term solutions with long-term benefits. However, as Du Pont’s announcement illustrates, you have little time to waste.

CFC refrigerants and ozone depletion

Developing a well-planned CFC-replacement strategy requires an understanding of the CFC issue itself. In the mid-1970s, Roland and Molina, two scientists from the Univ. of California at Irvine, developed a theory that says CFCs are depleting the earth’s protective ozone layer.
Among CFC replacement options is the replacement of old chillers with new ones that use non-ozone-depleting HFC refrigerants.

By Alan M. Bell, Vice President, McQuayService, SnyderGeneral Corp.

In March, Du Pont announced it would stop producing chlorofluorocarbon (CFC) refrigerants by Dec. 31, 1994—one year earlier than the deadline set by the U.S. government and the revised Montreal Protocol. Du Pont’s announcement is—or, at least, it should be—a major turning point for building owners and managers who currently operate CFC-based air-conditioning and refrigeration (AC&R) equipment but still have not decided upon an appropriate replacement strategy.

Suddenly, the need to develop a plan for replacing CFC refrigerants with ozone-safe alternatives is considerably greater than it was a few months ago. In short: When the world’s largest producer of CFC refrigerants decides to halt production 52 weeks earlier than anticipated, that decision squeezes an already tight replacement deadline all the more.

Most building owners, engineers and maintenance personnel who deal with centrifugal chillers know of the need to develop a CFC replacement strategy as soon as possible. However, many remain confused about their options.

For those who currently operate CFC-based centrifugal chillers, the approaching CFC phase-out deadline is even more critical because replacing a centrifugal chiller is a major business decision. Do not take that decision lightly.

Only one of three choices is possible:

• Purchase a new centrifugal chiller.
• Retrofit the existing machine with an ozone-safe alternative.
• Manage the containment of the CFC refrigerant.

The choices are simple and straightforward. Yet, unless facilities managers and engineers understand the CFC issue and the relative merits of alternative refrigerants, choosing the right one may be a daunting task.

Sorting the options

In the midst of the legislative mandates, production phase outs, misleading statements and general confusion that surround the CFC issue, three

migrate into the stratosphere. Once in the stratosphere, radiation breaks down the CFC molecules and releases chlorine ions that react with the ozone to form chlorine monoxide. In time, this process causes the destruction of ozone.

At first, many scientists and lay people were skeptical about the ozone depletion theory. However, today, few are disbelievers. In fact, as scientists continued over the past two decades to investigate ozone depletion, they found the situation to be more serious than previously thought.

Governments responded by enacting legislation that mandates the phase out of CFCs. The United Nations sponsored a meeting to address the CFC issue, and the results of that meeting became the Montreal Protocol. Revised in 1992, the Montreal Protocol calls for the halt of CFC production by Jan. 1, 1996, a date also mandated by the U.S. Clean Air Act. Both the Montreal Protocol and the U.S. Clean Air Act also call for the banning of HCFCs (hydrochlorofluorocarbons) at a later date. Although less harmful to the ozone than CFCs, HCFCs contain chlorine and also deplete the ozone layer.

As Du Pont’s announcement shows, government-mandated deadlines are only part of the movement to ban the use of CFCs. The HVAC industry as a whole is extremely aggressive in its efforts to phase out CFC-based technology. Early this year, for example, three leading manufacturers of centrifugal chillers stopped selling products designed to run on CFCs. The trend is clear. Refrigerants that have the potential to deplete the ozone layer soon will be things of the past. No building owner, manager, engineer or service technician can afford to ignore this situation.

Ozone depletion is a serious environmental problem. It merits replacing CFC refrigerants with ozone-safe alternatives. As for global warming, rather than focusing on any particular refrigerant, the best tactic available to facilities managers and engineers is to minimize carbon dioxide emissions by operating the most efficient AC&R equipment possible.

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alternative refrigerants emerged as the most popular replacement choices. They are HCFC-22, HCFC-123 and HFC-134a.

HCFC-22 and HCFC-123 contain chlorine. Their manufacture also will end at a date later than that for CFCs. By contrast, HFC-134a is a hydrofluorocarbon, not an HCFC. HFC-134a contains no chlorine. So, it has no potential for ozone depletion and is not destined to be phased out with CFCs and HCFCs.

As a result, one can reasonably argue that HFC-134a is the only one of the three leading alternative refrigerants that offers a realistic long-term solution for large tonnage centrifugal chiller applications. It simply does not make sense to purchase a new centrifugal chiller engineered to run on an HCFC refrigerant when we know the refrigerant will be phased out before the end of the useful life of the machine.

That is not to say HCFC refrigerants are poor choices for all HVAC systems. For smaller tonnage equipment with shorter useful lives, HCFC-22 is a good choice because no completely ozone-safe alternative is available. Also, buying a new centrifugal chiller is not the only option. If an existing CFC-based chiller still has several useful years ahead, retrofitting might be a better decision. Consider retrofitting negative-pressure centrifugal chillers that run on CFC-11 with HCFC-123. Also, HFC-134a replaces CFC-12 or R-500 in positive-pressure machines.

Retrofitting CFC-12 or R-500 centrifugal chillers with HFC-134a is considerably less expensive than purchasing a new unit. However, for hermetic machines, converting a CFC-11 chiller manufactured before 1989 to HCFC-123 requires a motor change and replacement of every gasket and O-ring. Consequently, the cost of retrofitting Continued...
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The economics of CFC management

By Les Davis, Director of Corporate Communications, Spectronics Corp.

Among the options for dealing with the CFC phase out is CFC management. CFCs are safe, stable and efficient inside equipment. However, when they escape into the upper atmosphere, they destroy the earth's protective ozone layer.

CFC losses cost U.S. industry millions

According to the Environmental Protection Agency (EPA), more than 35% of all CFCs presently produced are used in air-conditioning and refrigeration (AC&R) equipment, making it the largest user of CFCs. According to an industry expert, 60% of all CFC refrigerants currently are produced just to replace lost CFCs from AC&R equipment. A staggering 336 MM lb of these expensive refrigerants leak into our environment each year at an annual cost of nearly $1.2 billion.

As phase out starts, the supply of CFC-based refrigerants - a situation underscored by Du Pont's recent decision to cease production a year earlier than expected - higher demand, taxes and surcharges should cause CFC prices to soar.

Since leaking AC&R units have to work longer and harder than fully charged units to produce the same amount of cooling, they use substantially more energy. Figures from a major manufacturer of AC&R equipment indicate that leak-induced inefficiency wastes 20 trillion Btu in the United States each year. On the basis of figures from the New York State Department of Energy, that inefficiency translates into an additional $396 million loss for U.S. companies and institutions.

What you can do

Effective CFC management will save you money and, perhaps, allow you to postpone a costly replacement or retrofit. An effective management program includes these steps:

• Stop venting and “topping off” refrigerant. Leaks seriously damage the environment and deprive you of valuable re-usable or salable CFCs. Furthermore, fines for venting can cost you up to $25,000/kg per incident per day.

• Recover, recycle and reclaim refrigerant. As the CFC supply declines, these refrigerants will become harder to get and increasingly valuable.

Proposed EPA guidelines permit you to return recovered gas to the same unit after repair or to recycle it into any other equipment your company owns without restriction. However, your facility cannot use it in equipment owned by someone else without reclaiming it first. Reclaimers, who commercially clean and process used refrigerants, also will buy your surplus.

• Use leak detection. CFCs are safe, efficient and effective when they are inside equipment. They are harmful only when they reach the upper atmosphere. So, simple logic dictates keeping refrigerants in the equipment and finding and fixing leaks promptly.

A conscientious leak detection program coupled with a sensible repair policy could eliminate most of your facility's AC&R-related CFC emissions this year. Leak detection also will reduce your energy consumption, prolong your equipment's life and save you the cost of replacing expensive CFC refrigerants or immediately converting to alternatives.

How much can leak detection save you?

Although no doubt exists that leaks needlessly squander refrigerant, waste energy and cause premature equipment failure, predicting an exact dollar value is difficult. To get a fast estimate on your annual refrigerant savings, use Figure 1 (see p. 32). It assumes your facility's AC&R equipment leaks the average 30% of its total charge each year.

1) Add the total refrigerant capacity of your units together and find that number on the chart's baseline.

2) Locate your average cost per pound of refrigerant.

With UV-fluorescent leak-detection methods, leaks glow a bright yellow-green under a high-intensity ultraviolet lamp.

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Costs will vary from installation to installation, but a reasonable figure for either installing a new 500-ton HCFC-123 machine or retrofitting a 500-ton CFC-11 unit with HCFC-123 is in excess of $100,000. A new 500-ton positive-pressure centrifugal chiller engineered to run on HFC-134a costs about the same as an HCFC-123 chiller. By contrast, retrofitting a CFC-12 or R-500 unit with HFC-134a is less expensive, about $50,000.

In cases where using an ozone-safe alternative is not now feasible, managing the containment of the existing refrigerant is a good interim solution. (See sidebar, “The economics of CFC management.”)

A poor choice, today, would be to buy a new large-tonnage centrifugal chiller that might need replacing or retrofitting in the future. The costs of purchasing or retrofitting a large tonnage machine are too high to merit spending money on a solution that may not last over the long-term.

Presently, HFC refrigerants are the only ones facilities managers and engineers can count on to be manufactured for the long-term. Because HFC-134a offers high efficiency performance in positive-pressure centrifugal chillers (and in many other applications, as well), it is the most popular HFC refrigerant on the market today.

Facilities owners and managers, along with engineers and service technicians, no longer need to wait to start developing their CFC replacement strategies. For centrifugal chillers, interim and long-term solutions are here—2 years ahead of Du Pont’s and 3 years ahead of the government’s deadline for phasing out CFC production.

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For answers to questions on CFC replacement, contact Bell at McQuayService SnyderGeneral...
Free of the disadvantages of conventional methods, the UV-fluorescent system simultaneously locates multiple leaks and never gives false alarms. Tested to stringent ASHRAE standards, the additive does not harm compressors or other AC&R components. It remains in the unit permanently (unless someone changes the oil).

With UV-fluorescent leak detection, CFC management may be your company’s best immediate reaction to the phase out of CFCs.

Les Davis is director of corporate communications for Spectronics Corp., Westbury, N.Y. A journalist and engineer, Davis writes, directs and produces instructional videos on leak detection. Hundreds of his articles and technical papers have been published.

For answers to questions on UV-fluorescent leak detection, other related topics, a free videotape on pinpointing refrigerant leaks, or other related publications, contact Davis at Spectronics Corp., 956 Brush Hollow Rd., Westbury, NY 11590, or circle 112.