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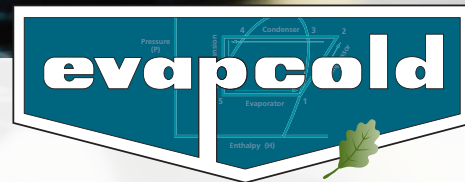
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COVER STORY

A growing number of supermarkets are moving to replace hydrofluorocarbons with climate-friendly alternatives, such as propane, ammonia and carbon dioxide, ahead of the planned phase out of R-22 in the United States, but grocers are moving forward cautiously.

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chairman's

MARK STENCEL

MESSAGE

“**W**hen anyone asks me how I can best describe my experience in nearly

forty years at sea, I merely say, uneventful. Of course there have been winter gales, and storms and fog and the like. But in all my experience, I have never been in any accident...or any sort worth speaking about. I have seen but one vessel in distress in all my years at sea. I never saw a wreck and never have been wrecked nor was I ever in any predicament that threatened to end in disaster of any sort.”

—E. J. Smith, 1907,
Captain, RMS Titanic

Despite our ability to assume that all is OK, humans are fallible and bad things happen.

It is the responsibility of each of us to perform our roles in a safe manner, for our own good, for the good of our colleagues, our customers, our families and for the community at large. In that regard, the building of the collaborative relationship between IIAR, the EPA and OSHA, all whom have safety at the core of their values, is worthy of our efforts and attention.

Both OSHA, through their National Emphasis Programs (NEP), and the EPA, through their National Enforcement Initiatives (NEI), have elevated their focus on ammonia refrigeration installations and

can apply penalties, which are never welcomed by the recipient, as one potential outcome of such activities.

While we are all aware of the potential negative outcomes of punitive actions, it should be noted that the goal to be served is to ensure the safe use of ammonia. As such, the EPA and OSHA are strong supporters of many of the non-punitive developments undertaken by

development of our IIAR-2 Certificate Program, which enables consistent documented evidence of attainment of knowledge of the safe practices detailed in the Standard.

Through the efforts of the IIAR Government Relations Committee, as well as our industry colleagues with the IRC, GCCA and ASTI, we have supported and embarked on several educational initiatives

Through the efforts of the IIAR Government Relations Committee, as well as our industry colleagues with the IRC, GCCA and ASTI, we have supported and embarked on several educational initiatives for the field personnel of EPA and OSHA.

IIAR and are participating in several of them.

The expansion and codification of IIAR-2, our industry's Safe Design Standard for Closed-Circuit Ammonia Refrigeration Systems, has enabled its' recognition by both agencies as RAGAGEP (Recognized and Generally Accepted Good Engineering Practices) for our industrial refrigeration applications. In September meetings held in Washington DC with both EPA and OSHA officials, they welcomed IIAR's educational initiative and the

for the field personnel of EPA and OSHA. This reflects our belief, and theirs, that knowledge of safe ammonia practices and ammonia system design benefits inspectors, emergency response providers, ammonia refrigeration practitioners and the communities we serve.

We have sponsored an education program, developed by IIAR Board Member, Doug Reindl, and the IRC, focused on building ammonia refrigeration knowledge for OSHA's CSHO's (Compliance, Safety and Health Officers). The program consists

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of weekly two-hour sessions, supplemented by homework assignments, extending over five weeks of instruction. The pilot program was attended by 30 CSHO's and PSM Coordinators from OSHA and the January session has been fully booked, with 40 participants from OSHA.

Upon completion of the five week workshop, it is intended that the OSHA participants will have familiarity with the major components comprising an ammonia system and their principles of operation. They will have developed an understanding of the engineered safety systems applied by our industry, as well as applicable RAGAGEP. Further, they will have obtained an understanding of the common failure mechanics that can compromise the integrity of an ammonia refrigeration system.

In further support of the knowledge attainment of the appropriate regulatory bodies, we have provided special access through our "government portal" to key elements of the IIAR website to representatives of OSHA, the EPA and the Department of Homeland Security. This enables review and study of IIAR Standards and Publications which serve as essential RAGAGEP for ammonia refrigeration.

With ASTI, we have developed an Ammonia Training Day targeting regulatory inspectors, local emergency planning committees and emergency response teams. The first of these, being held in EPA's Region 8 Conference Center in Denver, Colorado was held on November 16th and will be followed by three

similar sessions over the next year, with a planned Boston, MA based Ammonia Training Day being the next, scheduled in January.

IIAR's portion of the Safety Day's content, heavily focused on emergency response and emergency action plans, will be delivered by Dave Rule, IIAR President and Eric Smith, IIAR Vice-President and

and OSHA; the safe and reliable operation of ammonia and other natural refrigerant systems. The Government Relations Committee has become, again, a vital contributor to IIAR's progress.

IIAR's Vision and Mission both begin with the founding IIAR principle of advocacy. As a collective, with a membership

As a collective, with a membership reflecting a high percentage of engineers and technical leaders, [IIAR's] advocacy is not of the "pat on the back" variety but rather founded on development of sound engineering and operational principles, debate and consensus development of best practices and the education of all parties involved in moving our industry forward.

Technical Director. We are making the content of their presentations available to other regulatory agency employees through our website.

Four years ago, under the guidance of Joe Mandato, then IIAR Chair, we recognized the need for enhanced advocacy and "re-started" the activities of IIAR's Government Relations Committee, which had been disbanded. Under the leadership of Don Stroud, Committee Chair and by the efforts of its members, the Committee has served to lead processes that build upon the common goal of IIAR, EPA

reflecting a high percentage of engineers and technical leaders, our advocacy is not of the "pat on the back" variety. Rather the core of our advocacy is founded on development of sound engineering and operational principles, debate and consensus development of best practices and the education of all parties involved in moving our industry forward.

We have been well served by such an approach and we welcome and encourage the participation of all of our membership in continuing to keep our industry safe.



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president's

BY DAVE RULE

MESSAGE

This issue of the Condenser is all about change. Whether it's the regulations phasing out HFC's and the new decisions faced by many in the commercial and industrial world, or the innovations and new technology that are enabling those decisions – one thing is certain, we are moving rapidly into a new era of refrigeration. The future, in the form of new equipment and new ideas, will be on full display at the upcoming IIAR Annual Conference and Heavy Equipment Expo in San Antonio. And nothing is more important as we reach for that future, than our ability to enrich our collective knowledge in the form of education.

IIAR will be featuring the new IIAR-2 Certificate Program at the annual show, but I want to take this opportunity here, in the Condenser, to talk about what it means for us as an industry and why your participation as an IIAR member – not only in the IIAR-2 program, but in the association's broader education effort – is essential.

The IIAR-2 Certificate Program is the first offering under IIAR's new educational effort, which will eventually grow to include certificate programs for all

IIAR standards. The goal is to promote a comprehensive understanding of all IIAR standards across every sector of our industry.

One of the most important reasons for that is the IIAR suite of standards is basic RAGAGEP in all of our facilities. It is recognized by building codes, increasingly cited by regulators, and is becoming a growing force in influencing how our industry is inspected and regulated.

Every IIAR member, whether they are a manufacturer, contractor or engineer, needs to work with a basic knowledge of all IIAR standards because this is where the industry's RAGAGEP is coming from. It's the best method we have to address the growing regulatory impact on our industry. The group of IIAR standards educational courses will eventually ensure that all of our engineers are prepared to design and implement natural refrigeration systems safely. This is the reason that IIAR was instructed by its Board of Directors to create the Academy of Natural Refrigerants.

However, certificate programs for our standards suite is only the first leg in IIAR's much broader vision for the education program that is being built now.

The second leg of the program will focus on PSM/RMP and the

general duty clause. Knowledge of these areas is significant – because they are the cornerstone of all regulatory requirements and oversight in all facilities.

Finally, the third leg of IIAR's broader educational program will address basic engineering design elements and will be made up of classes on subjects like the material covered in IIAR's Piping and CO₂ Handbooks.

While each different facet of this program will be especially relevant to different sub-groups within our membership, every part of IIAR's ongoing education program will be an invaluable tool for every part of our membership. In fact, the value in this effort is that the new educational program is not about just taking one course or getting one certificate. It's an ongoing, long-term effort any IIAR member can embark on as part of their career development and personal advancement within the industry.

It's also a critically important effort we can take as a group and an organization with a leadership role in our professional community.

Together, we are creating an educational resource that will sustain and inform the regulatory community, our own managers, operators, engineers and facility owners, not to mention the next generation of professionals – for years to come.

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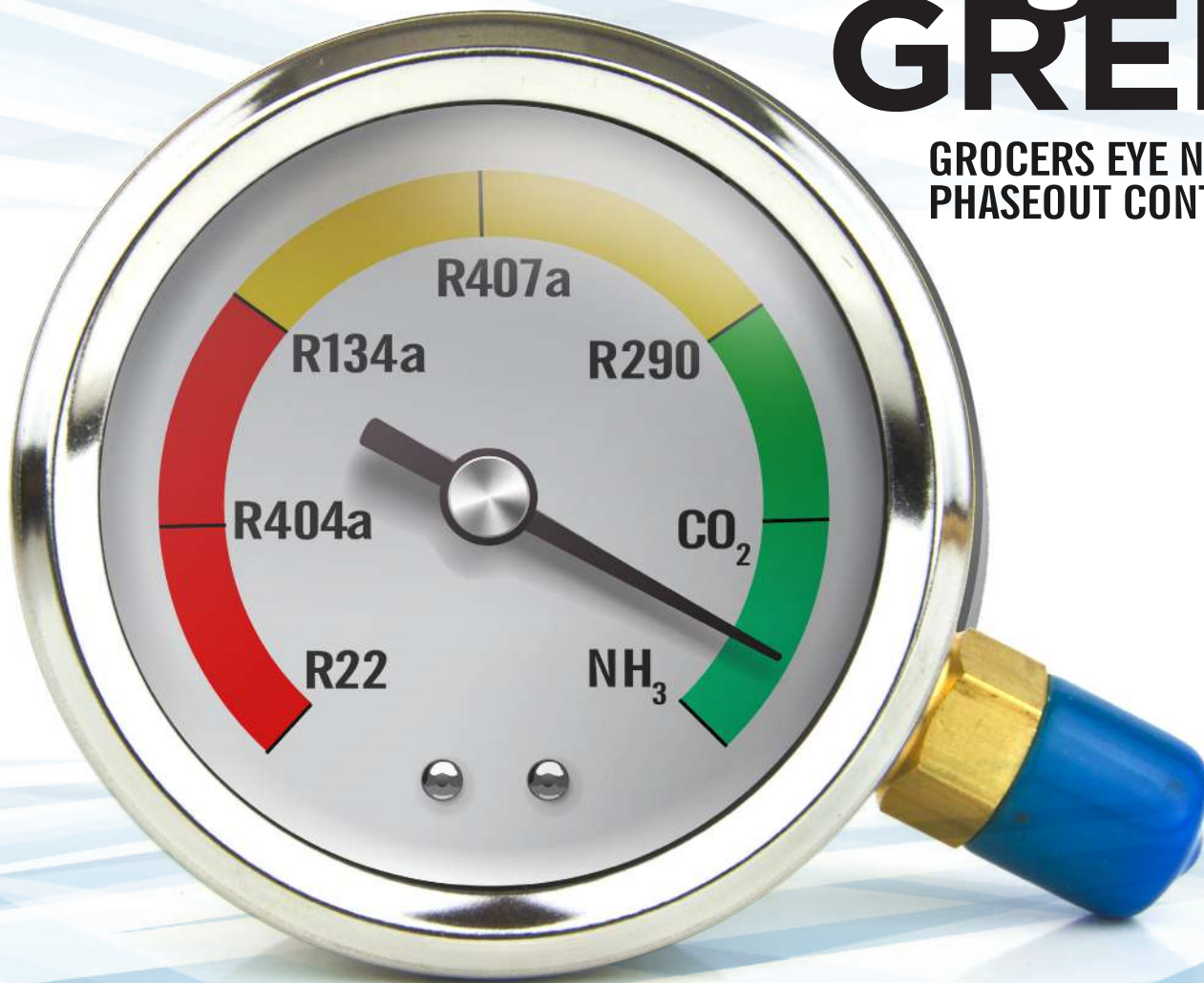
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GROCERS EYE NATURALS AS PHASEOUT CONTINUES



A growing number of supermarkets are moving to replace hydrofluorocarbons with climate-friendly alternatives, such as propane, ammonia and carbon dioxide, ahead of the planned phase out of R-22 in the United States, but grocers are moving forward cautiously.

“Some supermarket chains have been very progressive, choosing natural refrigerants for all new systems. Others are still installing new stores using R-404a, which as of Jan. 1, 2017, can’t be used for new or retrofit equipment but can still be used in already-

installed equipment,” said Liz Whiteley, executive director of the North American Sustainable Refrigeration Council. “Most are somewhere between those two extremes with respect to their transition,” she said adding that it is impossible to generalize about what supermarkets are doing.

Whiteley said that grocers are weary of change. “The retail food industry has been through more refrigerant transitions than perhaps any other industry that historically used CFCs and other ozone-depleting substances.” She said that one of the benefits of natural refrigerants is

that they’re phase-out proof. “Whether you’re talking about ammonia, carbon dioxide or any of the hydrocarbons, all natural refrigerants have such small global warming potential that they will never be subject to a phase out.”

Andre Patenaude, director of CO₂ business development for Emerson Climate Technologies, said natural refrigerants are being aggressively worked on right now. “We have to look at ammonia, CO₂ and propane more seriously, but although CO₂ appears to be the most dominant at this time, ammonia

and propane seem to be carving out their own space.”

There are 118 CO₂ systems in the U.S., but most U.S. retailers are still in the trial stage, Patenaude said. Companies have also tried small propane systems called micro-distributed architecture as well as ammonia chillers on the roof of their stores that circulate CO₂ as a secondary refrigerant. “There are all kinds of architectures being trialed in North America. Retailers are really not sure what to do,” he said.

In 2015, the Piggly Wiggly store in Columbus, Georgia, launched a refrigeration system that uses a hybrid ammonia-carbon dioxide cascade refrigeration system. The system’s manufacturer, Kysor/Warren, reduced the amount of ammonia refrigerant to 3/4 pound per ton of refrigeration totaling 53 lbs., which is confined to the roof of the supermarket.

Whole Foods Market has implemented several systems. In August, Whole Foods opened a 49,000-square-foot store in Santa Clara, California, that uses a propane-CO₂ cascade refrigeration system. The system uses about 265 lbs. of propane, which is spread across seven chiller units on the roof, to condense CO₂. In November, Whole Foods opened a location in Walnut Creek, California with a CO₂ transcritical system, this time utilizing parallel compression technology to help with efficiency in the warmer climate.

Whole Foods has also implemented an ammonia/CO₂ cascade system at its store in Dublin, California, and another

CO₂ transcritical system that uses subcooling off of the CHP at a store in San Jose, California, said Tristam Coffin, director of sustainability and facilities for Whole Foods Market.

“My goal now is to analyze real-time data on these systems to understand what our path forward looks like. The intent was to get the systems out there

how you evaluate them.”

Keilly Witman, owner of KW Refrigerant Management Strategy LLC, said self-contained hydrocarbon systems are promising. “Up until now everyone just assumed supermarket refrigeration was going to be some type of rack system. Now all of a sudden, because propane is

“My goal now is to analyze real-time data on these systems to understand what our path forward looks like. The intent was to get the systems out there so we could compare them side-by-side. We’d like to have two years of run time on all of the systems before making any programmatic decisions.”

Tristam Coffin, director of sustainability and facilities for Whole Foods Market

so we could compare them side-by-side,” Coffin said. “We’d like to have two years of run time on all of the systems before making any programmatic decisions.”

However, Coffin said he doesn’t think the company will settle on just one system as it is difficult to find a one-type-fits-all solution. “It is a matter of building type and climate-specific design,” he said, adding that he will be evaluating the total cost of ownership as well as the environmental impact of the systems. “One system might be better than another depending on

such a good, energy-efficient refrigerant, supermarkets have an option that uses propane self-contained cases for all the store’s refrigeration needs,” she said.

Target was the first company to make the commitment that every new self-contained unit will use propane, R-290, which Witman said is very important symbolically.

Target, which operates about 1,800 stores in the United States, also plans to use self-contained “rackless” refrigeration systems in its small-format stores, which should decrease refrigeration

Trader Joe's Agrees to Use Non-Ozone Depleting Refrigerants

Trader Joe's Co. has agreed to reduce emissions of greenhouse gases from the refrigeration equipment at 453 of its stores and use non-ozone depleting refrigerants at all new stores and major remodels.

The grocery chain agreed to the move under a proposed settlement with the U.S. Department of Justice and the Environmental Protection Agency. At least 15 of those stores must use advanced refrigerants, such as carbon dioxide, EPA said.

The agreement stems from a settlement Trader Joe's made to resolve alleged violations of the Clean Air Act. The federal government alleged that Trader Joe's violated the Clean Air Act by failing to promptly repair leaks of R-22, failing to keep adequate servicing records of its refrigeration equipment and failing to provide information about its compliance record.

Trader Joe's has not said what refrigerants it will pursue. Alison Mochizuki, a spokeswoman for Trader Joe's, said, "Trader Joe's looks forward to working with the EPA in its mission to reduce air pollution and protect the ozone layer, and, with this agreement, has committed to reducing its emissions to a rate that matches the best of the industry."

Under section 608(c) of the Clean Air Act, it is illegal to knowingly release refrigerant into the air, whether it is R-22 or an HFC substitute such as R-410A, R-134a or R-404A, EPA said. Enforcement actions can range from civil fines of up to \$37,500 per day for any violation of the section 608 refrigerant management regulations to criminal prosecutions," EPA said.

The agreement marks the first EPA settlement with requirements to repair leaks of HFCs in order to further reduce greenhouse gas emissions.

Approximately one-quarter of Trader Joe's equipment units use hydro-fluorocarbon refrigerants that are non-ozone-depleting, but have a high global warming potential.

"It is important to note that while 608(c) prohibits the venting of refrigerants such as R-22, unintentional leaks on their own are not a violation of the regulations," EPA said in a statement prepared for the Condenser. "If appliances that contain 50 or more pounds of refrigerant leak above the applicable leak rate threshold, the owner/operator of those appliances are required to take certain actions to repair those appliances."

Trader Joe's will now implement a corporate refrigerant compliance management system to comply with federal stratospheric ozone regulations and to detect and repair leaks through a new quarterly leak-monitoring program, EPA said. In addition, Trader Joe's will achieve and maintain an annual corporate-wide average leak rate of 12.1 percent through 2019, well below the grocery store sector average of 25 percent.

The settlement is the third in a series of national grocery store refrigerant cases, including cases previously filed against Safeway Inc. and Costco Wholesale Corp.

In 2014 Costco Wholesale Corp. agreed to cut its emissions of ozone-depleting and greenhouse gases from leaking refrigeration equipment at more than half of its stores nationwide as part of a settlement it reached with the EPA and U.S. Department of Justice. As part of the settlement, Costco agreed to pay \$335,000 in penalties for federal Clean Air Act violations and to fix refrigerant leaks and make other improvements at 274 of its stores.

Under the agreement, Costco was required to retrofit or replace commercial refrigeration equipment at 30 of its stores. Costco must also implement a refrigerant management system to prevent and repair coolant leaks and reduce its corporate-wide average leak rate at least 20 percent by 2017. In addition, Costco will install and operate environmentally friendly glycol refrigeration systems and centrally monitored refrigerant leak detection systems at all new stores.

EPA had said Costco violated the Clean Air Act by failing to promptly repair refrigeration equipment leaks of R-22 between 2004 and 2007. Costco also failed to keep adequate records of the servicing of its refrigeration equipment to prevent harmful leaks.

The Costco settlement came a year after Safeway agreed to pay a \$600,000 civil penalty and implement a corporate-wide plan to significantly reduce its emissions of ozone-depleting substances from refrigeration equipment at 659 of its stores nationwide in a first-of-its-kind settlement agreement with EPA and DOJ.

The settlement resolved allegations that Safeway violated the Clean Air Act by failing to promptly repair leaks of R-22 and failed to keep adequate records of the servicing of its refrigeration equipment. Under the agreement, Safeway was required to implement a corporate refrigerant compliance management system and reduce its corporate-wide average leak rate.

The increasing regulatory burden on HFC and other synthetic refrigerants is drawing focus to considerations of natural refrigerants for these and other supermarket chains around the country.

energy use compared with traditional technology.

The rackless systems will also keep grocery aisles warm during cold months with the heat that is rejected from self-contained cases, which will save additional energy. “Others talk about the need to do something with the heat that is rejected by self-contained units to carry it out of the store. But Target looks at that heat as a resource that can save energy and money,” Witman said.

THE R-22 PHASE OUT

Trader Joe’s Co. was recently cited for failing to repair leaks of R-22, but Witman said she doesn’t believe enforcement settlements or fines are motivating anyone to move to natural refrigerants. “The phase-out is spurring more action toward naturals than the risk of enforcement action,” she said.

Although R-22 is on its way out, there is still a tremendous number of supermarkets that are using it, Patenaude said. As supermarkets renovate, shifting to naturals or low-GWP options and moving away from R-22, they can redeploy the R-22 quantities to other stores. “That keeps the cost down and the availability of refrigerant there,” he said.

However, NASRC’s Whiteley said the general trend is that R-22 prices will increase. Beginning in 2020 the only R-22 for sale will either be stockpiled product that was produced prior to 2020, or reclaimed R-22. “Consequently, you see a growing focus within supermarkets on getting out of R-22,” she said.

An EPA spokeswoman told *Condenser* that the steady decrease in availability and increase in the price of R-22 over the past years probably is encouraging some companies to consider whether to install a new refrigeration system or retrofit an old one. “In addition, domestic and international policies and regulatory changes, combined

doesn’t make sense to keep the store operating on the old system.

THE NEED FOR EDUCATION

Coffin said there are challenges when it comes to installing systems that use natural refrigerants, particularly with educating the local municipalities and the communities. When Whole Foods put in its first transcritical system in Brooklyn,

An EPA spokeswoman told *Condenser* that the steady decrease in availability and increase in the price of R-22 over the past years probably is encouraging some companies to consider whether to install a new refrigeration system or retrofit an old one.

with concerns about greenhouse gas emissions, are driving equipment owners and operators to choose climate-friendly refrigerants when installing new or retrofitting old commercial refrigeration systems,” EPA said.

The EPA said it doesn’t have data indicating that leaks increase as R-22 systems age, and Patenaude said equipment can last 20 years or more if it is maintained properly. However, efficiency will decrease. “The efficiencies on compressors start to wear. Evaporator efficiency goes. Condenser efficiency goes. You start spending so much on maintenance that the cost of ownership goes through the roof,” Patenaude said, adding that it gets to a point where it

New York, in 2013, the grocer worked to educate the building and fire departments and made some tweaks to the system to appease the jurisdiction.

Witman of KW Refrigerant Management said one problem is that codes and standards haven’t necessarily caught up with the latest natural refrigerant technology. For example, codes and standards don’t exist for the use of more than 150 grams of propane in supermarkets. “Any supermarket that wants to move into hydrocarbon use as a whole-store-solution has to fight the codes, standards, and permitting battles on a local level each and every time they want to build a new store in a new location. That is an enormous

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time and cost burden to put on a supermarket,” she said. “You start over every time.”

Currently EPA limits the amount of propane that can be used in a stand-alone unit to 150 grams. “We have submitted an application to the EPA to raise the limit to one kilogram,” Witman said, adding that it can take over a year for an application to be approved.

NASRC is working to collect resources in its online library, and to create new documents to help supermarkets looking to use natural refrigerants navigate the process. “Even for companies like Whole Foods, each situation is unique enough that there seem to be a lot of challenges and complexities at start up that contribute to that upfront cost. Part of what will drive transition to natural refrigerants is when we have enough collective experience under our belts. The more we can share that experience with other end-users, the faster the market will move,” Whiteley said.

When it comes to effectively communicating safety, Witman said she believes the Department of Defense project at the Lackland Air Force Base in Texas, which used natural refrigerants in the base’s supermarket, is a good example. “They really went all-out in terms of communicating with the community about the system,” she said.

As part of the project, the engineering and design company did an ammonia-plume study, which examined the way leaked ammonia would travel away from the ammonia units on the roof. The test showed that, even under

the worst weather conditions and the most extreme leak conditions, the ammonia would disperse into the atmosphere rather than travel to any area where it might affect people, Witman said. “That is significant because it proves that ammonia is not only a fantastic option for supermarkets, but also it is a fantastic option for supermarkets anywhere in the country, including cities

could help spur use. Patenaude said utility companies are willing to offer incentives if retailers can prove their natural refrigerant solution is more efficient than their R-22 system. “The capital expenditure will be higher, but they may be able to reduce that by getting X amount of money from the utilities,” he said.

That strategy worked in Quebec, Canada, when utilities

“Between the enormous climate benefits of choosing a natural refrigerant over a mid- or high-GWP HFC, and the improved energy performance, there are benefits to both end-users and utilities in incentivizing the use of natural refrigerants.”

Liz Whiteley, executive director of the North American Sustainable Refrigeration Council

with large populations, where buildings are very close together.”

Witman said she feels that ammonia is lagging behind carbon dioxide transcritical systems and hydrocarbons mainly because of a lack of a champion. “There isn’t anyone out there singing the praises of ammonia in terms of an equipment manufacturer or end user,” she said, adding that ammonia is one of the best natural refrigerants available and it is efficient in any climate. “You can’t beat the energy efficiency and cooling capacity of ammonia.”

THE ROLE OF INCENTIVES

Overall, natural refrigerant systems are not at cost parity with 404a type of systems, and incentives

offered large incentives. “That caused independent owners to take a chance on CO₂,” Patenaude said. “They don’t have those incentives anymore, but it caused a shift.”

NASRC brought together end-users and utility representatives for a workshop this summer to discuss some of the challenges that end-users face when it comes to choosing natural refrigerants, such as cost, and how utility incentives could help advance the market for naturals.

“Between the enormous climate benefits of choosing a natural refrigerant over a mid- or high-GWP HFC, and the improved energy performance, there are benefits to both end-

users and utilities in incentivizing the use of natural refrigerants,” Whiteley said.

However, utilities face some hurdles in creating these incentive programs. “For example, if a retailer decides to install a state-of-the-art transcritical CO₂ system, in most cases that system is going into a new store,” Whiteley said. “So how do you choose a baseline to compare your new system to?”

THE RETROFIT CHALLENGE

Whole Foods has focused on natural refrigerants in new construction. “It is more economically feasible in terms of installation and space constraints to build new,” Coffin said, adding that he is looking closely at how to retrofit older stores.

“We are currently looking at what opportunities exist for transcritical CO₂ retrofits or even going to a subcritical system with perhaps a lower GWP HFO on the high side.”

Witman said there really is not a good way to move to natural refrigerants in existing systems. “If you want to move in an existing store from R-22 to a CO₂ transcritical system, you have to basically remove the existing system and build a new system,” she said.

One challenge is that most machine rooms are not large enough to allow a company to build a new unit next to an existing unit. “Nobody is going to shut down a store for a month to swap out the existing

refrigeration system and put in a new one,” Witman said.

GOING FORWARD

Despite the hurdles that exist, Whiteley said she expects the use of natural refrigerants to increase. “The market continues to get better and better for transcritical CO₂, especially with the variety of add-on technologies that help transcritical systems operate more efficiently in warm climates. There is also a lot of interest from supermarkets and utilities in hydrocarbon self-contained equipment,” Whiteley said. “When you look at natural refrigerants, they’re phase-out proof. Natural refrigerants are the end game. That is exciting, and is certainly a motivating factor.”



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IIAR HEAVY EQUIPMENT SHOW

The International Institute of Ammonia Refrigeration's 39th annual conference will provide four days of technical knowledge, networking and industry-sponsored events for those involved in the ammonia and natural refrigeration industry. The conference begins on Sunday, February 26, and concludes Wednesday, March 1, 2017.

The Sunday Education Program will focus on the application of "Recognized and Generally Accepted Good Engineering Practices" (RAGAGEP) in both new and older systems. This program is designed to educate people on the required documentation for the Process Safety Information element of PSM/RMP regulations as well as the application of RAGAGEP for new and existing facilities.

"It will cover the application of recognized and generally accepted good engineering practices and how they apply to regulated facilities as well as general duty clause facilities," said Eric Smith, technical director and vice president of IIAR.

In addition to providing an overview of PSM/RMP, the session will cover PSI documentation, including RAGAGEP, grandfathering, building codes and conflicts in RAGAGEP requirements.

The Sunday Education Program will also include application of ANSI/IIAR standards and bulletins,

and attendees will receive continuing education credits for their participation.

There will also be in-depth coverage of technical issues that have changed over time or caused confusion, as well as examples of things not to do or issues that have resulted in citations.

Richard Worzel, a futurist and a professional member of the World Future Society, will offer the conference's keynote address. Worzel is known for helping corporations and industry associations plan for the future and changes to come.

Ten workshops will take place during the conference. Tim Edwards from the Australian Refrigeration Association is scheduled to discuss the markets for natural versus synthetic refrigerants in Australia and some of the advantages and pitfalls. Richard Cerenzio with ISN will present on best-in-class contractor management. "He will essentially provide guidance to those who use contractors and subcontractors on their worksites — how to qualify them, how to manage them and how to direct them," Smith said.

As part of the workshops, Donny Pierce from Clemons Food Group will present problems and solutions for an existing pork processing facility. Chris Carter of Nestle Dryers Ice Cream will discuss saving time and dollars with oil filtration. Bill Lape from Dean Foods will present on how to conduct a proper process hazard analysis. Tom Wolgamot from DC Engineering



HEADS TO SAN ANTONIO!

will discuss commercial refrigeration considerations when using natural refrigerant system designs.

During the workshops, Liz Whiteley of the North American Sustainable Refrigerants Council will lead a session introducing the group and discussing its goals. Harshal Surange of ACR Project Consultants will discuss the essentials of a green cold chain facility, and Mark Bulmer of GF Piping Systems will lead a workshop on indirect refrigeration hydraulic loops. There will also be a workshop presented by Stifel, Nicolaus & Company, Inc. which will instruct companies and individuals alike on how to invest wisely for an uncertain future.

The IIAR Conference & Heavy Equipment Expo will also feature a panel of government officials, including representatives from the Occupational Safety Health Administration, Environmental Protection Administration and the Department of Homeland Security. "They'll be providing information on the latest rulemaking and enforcement efforts," Smith said.

A core feature of the conference is the presentation of technical papers, and nine will be presented this year.

Dave Rule, President of IIAR, said the conference will feature a full array of committee meetings, which will address upcoming priorities and work. Committee meetings are open to committee members as well as to those who would like to sit in as visitors. Being a part of the meetings allows members to observe

which topics are being addressed and the industry's top issues. The conference will also feature international committee meetings that bring people together from all parts of the world.

To give speakers and presenters an opportunity to share more about their businesses and new product technology, the conference includes a technomercial program, which provides a slightly more commercial aspect than other sessions. This year there are 12 half-hour technomercials, which will be held on the Exhibit Hall floor both Monday and Tuesday. Each session will last 30 minutes and includes a question and answer period.

Attendees will have an opportunity to connect with their peers through a number of networking opportunities, including the chairman's event and exhibitors' reception, in which members from all sectors of the industry come together to socialize and exchange ideas on what is going on through the industry.

The closing forum will address hot topics within the industry. "We will cover emergency response, operational containment, high pressure cut out testing and dual stamping of vessels," Smith said. "There is not a clear-cut approach to any of these topics, and we hope that the audience will consider these topics and provide feedback to the panelists."

Register for the conference online at www.iiar.org/Events.



2017 I I A R

NATURAL REFRIGERATION CONFERENCE & HEAVY EQUIPMENT EXPO

2.26.17 – 3.1.17

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WELCOME TO SAN ANTONIO AND THE 2017 I I A R REFRIGERATION & HEAVY EQUIPMENT EXPO!

It's time for our industry's greatest event, the I I A R Annual Conference & Heavy Equipment Expo! And while every year is a year that we look forward to catching up with colleagues and business partners, Heavy Equipment years are especially exciting because they offer a glimpse at the current state of the art in refrigeration technology, services and equipment.

This year, we're following Texas tradition – and going big – with the biggest expo, the biggest technical program and the biggest attendance on record. This year, nine technical papers, five international tech papers and nine workshops will round out the technical program for our record setting 1,700 attendees! That's the most robust technical program, and highest attendance for an I I A R show ever!

And whether you're a newcomer, or an old hand, you won't miss the significance of I I A R's return to San Antonio, where it all began back in 1979. I I A R held its first annual conference here in San Antonio that year, launching a nearly 40 year commitment to excellence and safety in refrigeration.

That commitment has never been more relevant than now, when environmentally sustainable technology is more relevant and essential than ever before. Our keynote speaker, futurist Richard Worzel will give us a glimpse of a sustainable future powered by technologies like natural refrigerants. Meanwhile, the special Sunday education session will this year focus on RAGAGEP, and will be an invaluable guide to making the right PSM decisions for new and existing facilities. And finally, we'll be recognizing those engineers that are the first to participate in I I A R's landmark Academy of Natural Refrigerants education program.

These are just a few of the highlights I'm looking forward to this year.

I would like to thank each and every company who has provided financial support to the I I A R and all of our members for their participation.

Welcome to San Antonio, and enjoy the conference!



SAN ANTONIO, TX

The Annual IIAR Natural Refrigeration Conference & Heavy Equipment Expo is the largest exposition dedicated to the ammonia and natural refrigeration industry. We provide an unrivaled opportunity for the industry's leading manufacturers, contractors, trainers, and other service providers to showcase their latest innovations and products. With over 1,500 in attendance last year, this is a perfect chance to network and collaborate with some of the greatest minds in the natural refrigeration community.

REGISTRATION IS NOW OPEN!

KEYNOTE SPEAKER

RICHARD WORZEL **LEADING FORECASTER AND FUTURIST**

Richard Worzel is a futurist and a professional member of the World Future Society. He is known for helping corporations and industry associations plan intelligently for the future. Worzel challenges organizations to examine the future and plan for the dizzying changes to come. In his compelling presentations, Worzel equips groups with the ability to understand the changes they will face in the years ahead, and with the tools to leverage those changes. He is known for his captivating speeches, workshops & seminars and Innovative sessions. His clients include Coca-Cola, Ford, IBM, Bell, The U.S. Navy Department of Medicine & Surgery, the National Research Council, the Clerk of the House of Commons of Canada, and many others. Worzel is a Chartered Financial Analyst and best-selling author of *Who Owns Tomorrow?* *7 Secrets for the Future of Business*.



WORKSHOPS

- **Commercial Refrigeration Applications**
Tom Wolgamot – DC Engineering
- **Natural versus Synthetic Refrigerants in Australia**
Tim Edwards – Australian Refrigeration Association (ARA)
- **Contract Management Best Practices**, Richard Cerenzio – ISN
- **Energy Efficiency and Operational Improvements for an Old System Overhaul**, Donnie Pierce – Clemons Food Group
- **Saving Time and Money Through Improved Oil Filtration**
Chris J. Carter – Dreyer's Grand Ice Cream, Inc.
- **How to Conduct a Proper PHA for NH₃ Systems**
Bill Lape – Dean Foods
- **Introducing the North American Sustainable Refrigerant Council**, Liz Whiteley – NASRC
- **Essentials of a Green Cold Chain Facility**
Harshal Surange – ACR Project Consultants
- **Indirect Refrigeration Hydraulic Loop**
Mark Bulmer – GF Piping Systems
- **Investment Strategies from Corporate to Individual Interests**, Jeff Howard – Stifel, Nicolaus & Company, Inc.

IIAR TECHNICAL PAPER PRESENTATIONS TO COVER AMMONIA PIPING

Technical papers set to be presented during the Technical Program at the IIAR Annual Conference will cover topics ranging from refrigerant quality to design principles.

Several presenters will discuss their findings in peer-reviewed technical papers.

A total of nine papers will be presented in English during the conference. In addition, there will be an International Program with five paper presentations. One paper will be in Portuguese and will cover experimental investigation on the performance and global environmental impact of CO₂ cascade refrigeration systems. There will be four additional papers in Spanish, which will cover ammonia in refrigerated seawater systems, the efficiency of a low-temp CO₂/NH₃ project operating in a tropical region and compare it with different configurations of NH₃ systems, water treatment for evaporative condensers, and the optimal energy-efficient path for reliable operation in NH₃ screw compressors in parallel applications.

Michael Elstroem, an expert in sensors and control technology for HB Products A/S in Hasselager, Denmark, will present his paper on new refrigerant quality measurement and demand-defrost methods. Requirements to reduce global warming potential and CO₂ emissions lead to pressures to use natural refrigerants, a development which has initiated numerous efforts and developments worldwide, particularly low-charge systems. Elstroem's paper describes a new sensor system for optimizing evaporator control, which includes a measuring principle for determining vapor quality and a demand-defrost sensor that measures ice build-up on the air-cooler surface.

Klaas Visser, a principal at KAV Consulting Pty Ltd., based in Victoria, Australia, will present a paper on applying NH₃ design principles to CO₂ systems. Visser said his paper will demonstrate that the application of evaporative condensers, commonly used in ammonia refrigerating systems, to the condensing of subcritical CO₂ and gas cooling of transcritical CO₂ fluid, will permit the efficient

application of CO₂ refrigeration worldwide if ammonia design principles are followed.

Bas Pijenburg and John Ritmann of Bitzer will present their paper, Parallel Compression for Low-Charge Systems, Parallel Operation of Screw Compressor Packs. Ammonia screw compressor packs utilizing parallel operation of two or three smaller industrial NH₃ screw compressors offer the optimum way when it comes to fulfilling maximum part-load efficiency, increased redundancy and other highly requested features in the industrial refrigeration industry today, the paper's authors said. Parallel operation can secure continuous operation and in most applications can be configured to ensure lower overall operating economy. New compressors are developed to meet requirements for flexibility in operation and are controlled in an intelligent way.

"The intelligent control system must keep focus on all external demands, yet strive to always offer the lowest possible absorbed power, including future scenarios with connection to smart grid," Pijenburg and Ritmann said. "This paper builds on top of and includes most of the results of an earlier investigation to show how to realize a series of compressor packs, following basically the results of these findings."

Placement of ammonia piping as well as other utility lines and equipment on the roof of a building has been done for years and there are many reasons and advantages to running service lines there. However, this exposes the equipment to other conditions: elements that are not a factor when piping is placed inside the building envelope. There are established codes and standards that outline a minimum basis for the design and installation of building structures, components and systems. Robb Davis, senior engineer for MIRO Industries, will discuss his research on code requirements for evaluating rooftop equipment and their supports. As part of this session, Davis will discuss the sections of the International Code Family that specifically address the requirements for supporting refrigeration

PLACEMENT, LOW-CHARGE SYSTEMS

equipment located on the roof of a building and how the applicable loading requirements affect the design of the supporting elements.

Ammonia (R717) and carbon dioxide (R744, CO₂) have received increased recognition as non-ozone depleting and low global warming potential refrigerants and they are receiving increased attention from OEMs. The paper titled "Assessment of Lubricants for Ammonia and Carbon Dioxide Refrigeration Systems" by Glenn Short of BVA Inc. will discuss the current types of lubricants used with these two refrigerants and emphasize new information which may be of interest to compressor designers and end users.

Economic pipe sizes are an important factor in project design and analysis for any piping system. The ammonia refrigeration industry currently uses a variety of methods to determine appropriate pipe sizes for a given service. These range from rules of thumb to table sizing to, in some cases, sophisticated proprietary calculation software that provides a great deal of information regarding a selected pipe size and its performance in the specified service. Currently there is not a detailed method, based on verifiable and easily updatable data, to look at and compare the life cycle cost of several pipe sizes side-by-side, with sufficient flexibility to fit a wide number of circumstances. Robert Sterling of Sterling Andrews Engineering, PLLC will present his paper resulting from research funded by the Ammonia Refrigeration Foundation. The paper's title is, "Method for Determining Best Economic Pipe Size for Ammonia Refrigeration Piping." The paper includes information on an updated method for determining a lowest-life-cycle-cost pipe size for ammonia refrigerant piping, which is intended as a tool for use by the industrial refrigeration industry and could be adapted for a wide audience.

A liquid desiccant system can provide cooling for the refrigerated space and eliminate the need for defrosting. Mark Piegay of Alpha Laval-Kathabar will present a paper titled "Refrigeration Applications

Utilizing Liquid Desiccant Dehumidification Systems," which explains three different scenarios where a subfreezing [$>32^{\circ}\text{F}$, 0°C] refrigerant is used to provide cool, humidity controlled process air with a liquid desiccant system. Each of these cases includes a discussion on how the installation's primary refrigerant is utilized and designed. The first case is a brewery's fermenting cellar, the second is a meat cooler and packaging space and the third is a cold storage staging area application.

Mario Mora Carli, president of Frigoconsult and a professor at the University of Costa Rica, will present a study of the energy consumption of a CO₂/NH₃ cascade industrial refrigeration system operating in Costa Rica and a comparison with direct ammonia systems in one and two-stage configurations. There are several research papers in Europe and the United States that claim that only below certain low-suction temperatures CO₂ will offer energy savings over an ammonia system, Carli said. His paper provides additional knowledge and real-case examples on the subject and presents the study of a CO₂/NH₃ cascade industrial refrigeration system with more than three years of successful operation in Costa Rica. It also gives a comparison with direct ammonia systems in one and two-stage configurations.

Finally, a paper titled "Energy Performance of Low-Charge, Central Type, Dual Stage NH₃ Refrigeration Systems in Practice" will be presented by Stefan Jensen of Scantec Refrigeration Technologies Pty. Ltd. The paper describes the energy performances of several refrigerated distribution centers with storage volumes of approximately 10,000 to 50,000 m³ (353,000 to 1,766,000 ft³). "The performance evaluations are based on the electrical energy consumption as measured by the electrical energy providers over representative periods of time," Jensen said in the paper. "All systems are serviced by central, state of the art low-charge, dual-stage NH₃ refrigeration systems. In the case of one plant the contribution of the photovoltaic panels to the energy requirement of the facility as a whole is shown on a month-by-month basis."

TECHNICAL PROGRAM SESSIONS

TECHNICAL PAPERS

- **New Refrigerant Quality Measurement and Demand Defrost Methods**
Michael Elstrøm – HB Products A/S
- **Applying NH₃ Design Principles to CO₂ Systems**
Klaas Visser – KAV Consulting Pty., Ltd.
- **Parallel Compression for Low Charge Systems**, Bas Pijenburg – Bitzer
- **Code Requirements for Evaluating Rooftop Equipment and their Supports**
Robb N. Davis – MIRO Industries, Inc.
- **Assessment of Lubricants for Ammonia and Carbon Dioxide Refrigeration Systems**, Glenn D. Short - BVA, Inc.
- **Method for Determining Best Economic Pipe Size for Ammonia Refrigeration Piping**, Robert A. Sterling - Sterling Andrews Engineering, P.E.
- **Refrigeration Applications Utilizing Liquid Desiccant Dehumidification Systems**
Mark Piegay - Alfa Laval
- **Study of the Energy Consumption of a CO₂/NH₃ Cascade Industrial Refrigeration Systems Operating in Costa Rica and Comparison with Direct Ammonia Systems in One and Two-Stage Configurations**
Mario Mora Carli – University of Costa Rica
- **Energy Performance of Low Charge, Central Type, Dual Stage NH₃ Refrigeration Systems in Practice**
Stefan Jensen – Scantec Refrigeration Technologies Pty. Ltd.

INTERNATIONAL PAPERS

- **Experimental Investigation on the Performance and Global Environmental Impact of CO₂ Cascade Refrigeration Systems**
Enio P. Bandarra Filho – Federal University of Uberlandia
- **Ammonia in RSW Systems**, Alberto Mayer – AMRISA
- **Evaluating the Efficiency of Low Temp CO₂/NH₃ Project Operating in a Tropical Region and Comparing it with Different Configurations of NH₃ Systems**, Mario Mora Carli – University of Costa Rica
- **Water Treatment for Evaporative Condensers**
Jorge Hernandez and Stephanie Fernandez – Baltimore Aircoil Company
- **NH₃ Screw Compressors in Parallel Applications: The Optimal Energy-Efficient Path for Reliable Operation**, Allesandro da Silva – Bitzer

IIAR offers simultaneous interpretation services for all English language technical papers in Spanish and all international presentations in English.

FOR A COMPLETE LIST OF CONFERENCE EVENTS AND ACTIVITIES OR TO REGISTER ONLINE, VISIT WWW.IIAR.ORG-EVENTS.



IIAR SUNDAY EDUCATIONAL PROGRAM ON

RAGAGEP

SUNDAY, FEBRUARY 26, 2017 • 1:00 – 5:00 PM

WHAT YOU WILL LEARN

Speaker topics include:

- Overview of PSM/RMP
- PSI documentation including RAGAGEP
- Establishing and updating RAGAGEP
- Discussion of “grandfathering”
- Review of applicable ANSI/IIAR standards and bulletins
- Building codes
- Addressing conflicts in RAGAGEP requirements
- And much more...

This program is to educate people on the required documentation for the Process Safety Information element of PSM/RMP regulations, and the application of RAGAGEP for new and existing facilities. Each attendee will receive CEU credits for their participation in the program.

There will also be in depth coverage of technical issues that have changed over time and/or which have been the source of some confusion, and examples of things not to do or issues that have caused citations. An interactive Q&A session will round out the agenda.

REGISTRATION NOW OPEN

Registration Fee: \$375.00

RAGAGEP PROGRAM SPEAKERS

Eric Smith

Vice President and
Technical Director of IIAR

Bob St. Jean

President
Ammonia Safety Management, Inc.

Peter Thomas

President
Resource Compliance, Inc.

Max Lindsay

Process Safety Engineer
ComPSM Inc.

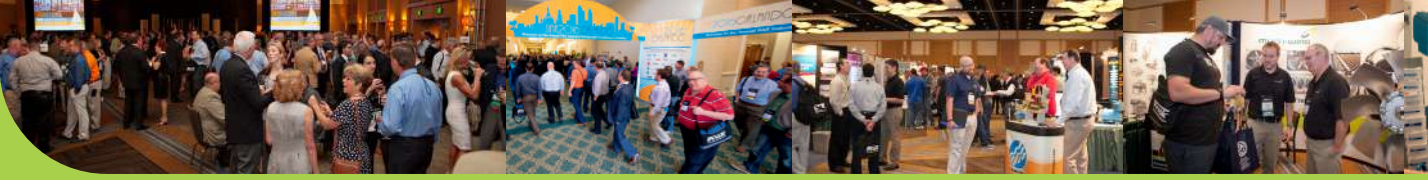
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Exhibit Hall Lunch – Monday, February 27



Afternoon Coffee Break – Tuesday, February 28

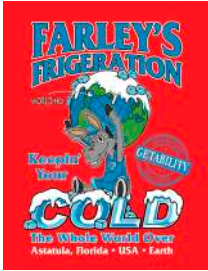


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Conference Wi-Fi



Convention Center Column Wrap



Continental Breakfast – Tuesday, February 28



Tootsie Plaza at Sunset Station – Monday Night, February 26



Multi-Tool



INDUSTRIAL REFRIGERATION

Meeting Registration Bags



Committee Meeting Coffee Breaks - Sunday, February 26



Bag Drop



The Depot Lounge Sunset Station - Monday Night, February 27



Water Bottles



Registration Map



Pocket Program



Business Meeting Chair Drop



Convention Center Column Wrap



Afternoon Coffee Break
Monday, February 27



Continental Breakfast – Monday, February 27



Morning Coffee Break – Monday, February 27



Morning Coffee Break
Tuesday, February 28



Conference App



Badge Lanyards



Chairman's Reception – Sunday, February 26



Bag Drop



First Timer's Reception – Sunday, February 26



Conference Notepads



Hotel Room Keys



Bourbon Street Piano Bar Sunset Station
Monday Night, February 27



2017 EXHIBITORS

- | | | | |
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| Chester-Jensen Co., Inc. | Henry Technologies | MIRO Industries, Inc. | Th. Witt |
| CIMCO Refrigeration Inc. | Henry Technologies Ltd. | MRBraz & Associates | Thermal Seal Duct Systems |
| Climate By Design International (CDI) formerly Concepts and Designs, Inc. | Hermetic Pumps | Multi-Wing America | Therma-Stor, LLC |
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THE HENRY B. GONZALEZ CONVENTION CENTER

The 2017 IAR Natural Refrigeration Conference & Heavy Equipment Expo will be held at the Henry B. Gonzalez Convention Center, nestled in the heart of historic downtown San Antonio, and directly next to our host hotel, The Grand Hyatt San Antonio. Newly renovated and with more than 500,000 square feet of continuous exhibit space, 70 meeting rooms and two ballrooms, the convention center will be the primary location for all of our 2017 technical sessions and exhibits.

ABOUT SAN ANTONIO, TEXAS

The city of San Antonio Texas is the third largest and second most populated city in the state of Texas. Located on the border of Central and South Texas, its most well-known landmark is the Alamo. Other national attractions include; the River Walk, the Towers of the Americas and entertainment venues including; SeaWorld and Six Flags Fiesta Texas theme parks. It is visited by more than 28.1 million visitors annually and its downtown is one of the liveliest in the nation.



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2.27.17 • 6:30-9:00 PM

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IIAR-2 Certificate Program

There is still time to register!

The IIAR-2 Certificate program is designed to educate natural refrigeration professionals in specific comprehension of material related to the ANSI/IIAR-2-2014 Standard for Safe Design of Closed-Circuit Ammonia Refrigeration Systems.

Participants will receive a certificate after completing a course and passing a comprehensive assessment test, the first of which will be administered at the 2017 IIAR Natural Refrigeration Conference & Heavy Equipment Expo in San Antonio, TX February 26 – March 1, 2017.

The IIAR Certificate Program addresses the new IIAR 2 Standard. As the definitive design safety standard of the ammonia refrigeration industry, information contained in the IIAR 2 Standard is crucial for the understanding of design safety in our industry. Professionals successfully completing a training class and the exam will receive a certificate from IIAR recognizing their competency of the IIAR 2 Standard.

IIAR is committed to our members' continued development. An education certificate will give you the opportunity to make a difference in your chosen field.

Modules can be reviewed On-Demand through the IIAR Learning Management System.



Our Mission is to provide advocacy, education, and standards for the benefit of the global community in the safe and sustainable design, installation and operation of ammonia and other natural refrigerant systems.

For more information and program updates, please go to www.iiar.org → Education → Certificate Program

ANSI/IIAR 2-2014 Certificate Program Syllabus

The IIAR 2 Certificate Course includes eight training sessions, typically an hour or less, given as a PowerPoint presentation with a voice over. At the end of each module, there are questions to check comprehension of the material. Once comprehension is demonstrated, you can move onto the next module. To receive a certificate, participants will be required to pass a comprehensive examination for the course.

This program allows attendees to work at their own pace. Modules 1-6 are available On Demand once registration is complete. You must view and test out of all 8 modules before you can sit for the final examination. You will receive detailed instructions on how to attend courses and access the materials as it becomes available.

ENROLL NOW

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Module 1 – General

Module 2 – Part 1 – Design and Installation Considerations Affecting Construction

Module 3 – Part 2 – Design and Installation Considerations Affecting Construction

Module 4 – Part 1 – Equipment

Module 5 – Part 2 – Equipment

Module 6 – Part 3 – Equipment December 14, 2016 2:00 PM EST

Still to Come!

Module 7 – Part 1 – Appendices

January 4, 2017 2:00 PM EST

Module 8 – Part 2 – Appendices

January 25, 2017 2:00 PM EST

Final Certificate Examination will be administered at the 2017 IIAR Natural Refrigeration Conference & Heavy Equipment Expo on Sunday February 26th, 2017 and Tuesday February 28th, 2017 – (*Exam time TBD*).

Course Requisites

We recommend these minimum requirements for individuals interested in participating in this program:

- General knowledge of the physical properties of ammonia
- Familiarity with design and installation considerations affecting construction of closed-circuit ammonia refrigeration systems
- Working knowledge regarding equipment that may be employed in operational closed-circuit ammonia refrigeration systems

Member Price: \$795.00

Non-Member Price: \$1,590.00

Structured discounts are available for multiple persons from one company. Contact IIAR for rates and registration.

Learning Objectives

After completing this program, learners will be able to:

- Describe appropriate and safe location of ammonia refrigeration equipment and outline general design requirements for construction of closed-circuit ammonia refrigeration systems
- Discuss design and installation considerations for machinery rooms and requirements for refrigeration equipment located in areas other than machinery rooms
- Understand safe installation and proper operation of equipment that may be employed in closed-circuit ammonia refrigeration systems including: compressors, refrigerant pumps, condensers, evaporators, pressure vessels, piping, packaged systems and equipment, overpressure protection devices, instrumentation and controls, and ammonia detectors and alarms.

Awareness

BY KEM RUSSELL

Are you “aware” in all, or at least most of the aspects of your life? Awareness implies that you have knowledge of something by maintaining a level of alertness in observing or in interpreting what you see, hear, feel, etc. Some people are very aware, but most of us limit our awareness to what we concentrate on. We focus so much on a specific “thing” that we don’t realize there is a forest of “things” out there, with many potential outcomes that can impact us for good or bad.

For me, a lack of awareness has happened more than once, and likely for you too. Have you had an experience similar to the following? I go to a jobsite and review a system that is either being constructed, or I am looking for some possible cause for an operational problem. I return to the office, and after analyzing what I saw and, or, heard, I realize I can’t recall some specific aspect of the system or equipment that may be important, even though was I looking right at it. Fortunately for me and possibly you, this type of “lack of awareness” doesn’t occur nearly so often with the use of (as approved) digital photos of my observations. Truly, a picture can be worth a thousand words.

Many times, a lack of awareness happens because we are focused on something specific, which reduces our awareness of other things happening around us that might be important. We don’t see what is there. For example, I recently hiked over several hundred

miles of the Pacific Crest Trail in the mountains of Northern California. The scenery was beautiful, however, at least for me, the trails required my near constant focus – so I wouldn’t twist an ankle or catch my foot on a root, a rock, or fall on or off the trail. Although I was hiking alone, I saw other hikers every day. In particular I became acquainted with two young men that were going

We focus so much on a specific “thing” that we don’t realize there is a forest of “things” out there, with many potential outcomes that can impact us for good or bad.

my same direction and I would bounce ahead and behind them as we hiked through Northern California. One afternoon while we were all together having a break, one of the younger hikers mentioned he had so far seen fourteen bears in the last few hundred miles. What! I hadn’t seen one. I am sure they were there. If I had just looked around and observed, I know I would have seen at least some bears. As it was, I blindly plodded along, focusing mainly on the trail, unaware that many times near me was one of the largest creatures that lived in these mountains, and one that might have been as interested in my food as I was.



LESSON

LEARNED?

Lack of awareness may also be associated with not hearing, or taking appropriate actions based on what we hear. Many years ago I went with my Dad to help with modifications on a large fish processing ship in Alaska. When we first came on board we were given a tour to familiarize us with the ship layout, which included the engine room where the generators were located that provided all of the ship power. I noticed that the main generator made a funny “chirping” sound, which no one seemed to notice or think was important. After settling into our state rooms (loose use of the term), we soon began the modifications to the ammonia refrigeration system. A few days later the

lights flickered, and went out all over the ship. Knowing of my dad's skills and reputation, the Captain ask him to respond with the ship's maintenance crew to the main engine room. The main generator had released the "chirp", and blew out a large chunk of the generator wall, throwing hot oil onto the adjacent wall, where unfortunately, was located some of the main electrical circuits and switch gear.

During the next several hours the ships maintenance and operations people worked along with my dad to bypass the burned out electrical gear and circuits and finally succeeded in getting another generator online and connected to the proper circuits. The generator failure was bad enough, but just before this event happened, a large load of shrimp had been delivered to the ship to be processed in the immersion freezer. With all electrical power off-line, there was no way to freeze the shrimp so they sat on the deck. After 24 hours, the shrimp were well past the point of being usable. The smell was unforgettable, and I didn't have much of a taste for shrimp for some years after that.

Here is another example of awareness, this time considering feelings. In some situations you may have just a feeling, hunch, whatever you want to call it, that something is just not right.

Many years ago a very good friend of mine, Patrick Johnson, responded to an ammonia leak at a facility in Shreveport, Louisiana, where he served as a Fireman. During this incident, more than once, Patrick had the feeling that something just wasn't right. They had followed proper procedures in responding by briefly referring

to the information sources they had about ammonia, which at that time didn't alert them to some critical information. They did not know that under certain conditions and at high concentrations, ammonia vapor could ignite.

The first entry into the facility, and the room where the ammonia leak was located, was made by two of the facility personnel along with two fire fighters. All of them had on SCBA's, but the facility personnel did not have on totally encapsulating suits. Due to the high PPM of ammonia in the room, the facility maintenance men soon began feeling a burning sensation under their clothes and couldn't stay in the room. Patrick's partner Percy noticed that the facility men were gone, and they decided to also leave. Once outside, they saw the facility men being washed down to stop the burning sensation of the ammonia on their skin. After further discussion with the maintenance men, it was decided to try one more time. After seeing what had happened to the maintenance men, and recalling the condition in the room where the leak was located, Patrick had an uneasy feeling about the situation. Percy felt it was worth trying again, so together they decided to make a second entry.

Unfortunately, not long after entering the room the second time, a spark was created when the forklift being used changed directions, and the ammonia in the room ignited. Both Patrick and Percy were wearing butyl rubber totally encapsulated suits, which mostly melted. Patrick was severely burned and has had to live with the results of those burns all his life. Patrick became

a strong advocate for the use of ammonia, and the safe and proper response to ammonia incidents. Over the many years I've known Patrick, he often wondered how would things have turned out had he just followed his "gut feeling?"

At the IIAR Annual meeting in 2016, the keynote speaker was Dr. Joe MacInnis. He gave an informative, fascinating, and extremely interesting talk. In the book Dr. MacInnis wrote titled "Deep Leadership Essential Insights From High-Risk Environments," in the chapter "Fierce Ingenuity," he makes a statement that relates to our awareness. He says, "To prepare for the hard moments, you master all the details. There are hundreds, maybe thousands of them and they contain the truth about your state of readiness. Ignore them and you expose yourself to hasty and superficial decisions."

Awareness can be, and many times is, critical to our proper response to the world around us. Being aware is not a one-time thing, where you are aware and always will be aware. To be aware we must consciously think about the details – such things as: what am I doing, where am I, what is around me, who else is around me, what are the potential results from my actions, what do I hear, see, feel, etc. In our field of industrial refrigeration (as well as other aspects of life) work on improving your awareness and thus improve your state of readiness to make the best decisions. Taking the appropriate actions at the time they are needed is always worthwhile.



news

LOIS STIREWALT O'CONNOR
EXECUTIVE DIRECTOR, AMMONIA
REFRIGERATION FOUNDATION

Ammonia Refrigeration Foundation Celebrates 10th Anniversary



10 years Young and Moving Forward

ARF Board Chair, Tom Leighty (left) and IIAR Board Chair, Mark Stencel (right) cut the 10th anniversary cake during a break at the October IIAR Board meeting, in Alexandria, VA.

The Ammonia Refrigeration Foundation marked its tenth anniversary on October 24, 2016. This past year gives us much to celebrate with several accomplishments that will keep the Foundation moving in a positive direction.

Important achievements include several moves that put the Foundation on sound financial footing and advanced the Foundation's program in several ways.

Of note is the establishment and approval of the first budget for the Foundation, a new website, online giving capability, creation and implementation of annual giving

program, direct mail and email strategies. As a reminder, all of this has been accomplished since March of this year!

Crucial to the success of these programs and initiatives, is the commitment of the volunteer leadership to make the Foundation a priority into their personal philanthropic plans. A wonderful testament to this fact, is the ability to announce with pride that 100% of the current Foundation board has either made a gift or pledge toward the 2016-2017 goals!

The Foundation thanks the two newest members of the Trustee's Circle – JCI/Frick

Corp. and past ARF-Chair Marcos Braz. Mr. Braz's recent pledge of \$50,000, marks his commitment and dedication to the future of the natural refrigeration industry. "I was honored to serve as the chairman of the board of both IIAR and of the Foundation. I support and believe in the mission and future and want to support the development of talent for this industry," said Braz.

JCI/Frick echos their long history and commitment to the industry with their \$50K gift. **Thank you!**



Ed Milligan of JCI/Frick signs Foundation pledge

We Appreciate Your Appreciation

Did you know that you can support any charity or non-profit of your choosing and not impact the way you live day to day? For instance, you can designate the Ammonia Refrigeration Foundation to receive estate assets in the future, or you can make immediate gifts from assets that are "out of sight and out of mind."

If you find yourself at year end needing more tax deductions, consider giving your appreciated securities to the Foundation. If sold, you pay tax on the difference between the base of the purchase price and the sale price, however, if donated directly to your non-profit of choice, you receive a tax break.

One of your highest tax-liabilities is the deduction from your IRA. For those over 70 ½, the mandatory withdrawal is tax-able, however if immediately designated to your non-profit of choice, that deduction is free from taxation.

We often call these "Gifts Anyone Can Make" because donors can make them now without impacting their current cash flow, lifestyle, or family security. Look for more information about this in future Newsletters and Online, in the meantime please visit: nh3foundation.org/plannedgiving.

So yes — ***We appreciate your appreciation!***

The Second Annual William E. Kahlert Memorial Golf Tournament



February 25, 2017

**The Quarry Golf Club
San Antonio, TX**

11:30a.m. Shotgun Start

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WILLIAM E. KAHLERT
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For more information, e-mail us at golf@nh3foundation.org.

The Ammonia Refrigeration Foundation is a 501(c)(3) education and research organization celebrating 10-years of support to the natural refrigeration industry.



AMMONIA REFRIGERATION FOUNDATION
www.nh3foundation.org

 In conjunction with the 2017 IIAR Natural Refrigeration and Heavy Equipment Show, February 26 - March 1, 2017 • San Antonio, Texas

Join us Saturday, February 25, 2017 at the Second Annual William E. Kahlert Memorial Golf Tournament in San Antonio, Texas. This is the day before the IIAR Heavy Equipment Show begins at the Convention Center.

The Lifetime Golf Chairman, Dennis Anderholm, is pulling out all of the stops for this Second Tournament.

"We want 100 golfers! If you register now, you have plenty of time to select your winning team!" encouraged Anderholm.

An all-inclusive tournament, it gives those involved the opportunity to build upon the existing camaraderie of our industry and to simply have fun. As always, the



proceeds of this event support the education and research initiatives of the Foundation.

The day will begin with transport to the Quarry Golf Club via buses from the IIAR Conference hotel (The Grand Hyatt). Shotgun start will begin at 11:45am.

For additional competitive fun: there will be a putting contest with a chance



to win a high-quality putter, as well as Longest Drive, Longest Putt and four Hole in One contests. The event will conclude with a small reception prior to transport back to the hotel.

Because this tournament was created to financially support the Foundation, your participation and sponsorships count

toward the new Foundation annual fund giving program and levels. As such, you will be invited to the IAR VIP Reception where prizes for the winning teams and individuals will be presented.

At the time of publication, the sponsors of the tournament include Innovative Refrigeration, Colmac, The Kahlert Foundation,

Evapco, Logic Technologies and Calibration Technologies. Sponsor availability and registration forms can be found on the Foundation website. Please visit: nh3foundation.org and click on "Golf." Or email golf@Nh3foundation.org

Scholarships

The International Institute of Ammonia Refrigeration/Ammonia Refrigeration Foundation Scholarship Program so far has committed \$6,000 annually. In the 2017 cycle, the plan is to commit \$7,000 to three students in the 2017 cycle and to continue that level of financial support annually.

Providing more funds will aid the students in achieving their educational goals, and the program is an important way to promote the natural refrigerant industry and attract outstanding engineering and technical students who seek careers in the profession.

The scholarship includes registration, travel, lodging and meals associated with attendance at the Annual IAR Industrial Refrigeration Conference & Exhibition, giving the scholarship recipients an opportunity to learn about the refrigeration industry and meet representatives of many companies who are seeking talented young mechanical engineers with an interest in this industry.

Key dates for this year's program are:

January 31, 2017- application deadline;

March 1, 2017 - scholarship awards announced at the IAR conference;

July 1, 2017 – the funds will be available for payment.

Thanks to our wonderful IAR member involvement, this year's ARF undergraduate engineering scholarship recipients, Andrew Re and Jacob Upton, had a great opportunity to get real hands on experience in the industry!



Commenting on his internship, Andrew Re said, "I've been an intern at Bassett Mechanical for the past two summers and not only has it been an extraordinary learning experience both in terms of academic and business knowledge, it has helped me narrow down my choices into which field I want to enter post-education. Through my internship here I've built team working skills through the assistance of the senior engineers which I worked under, reinforced my knowledge of fluid and thermodynamic systems and applications, and acquired valuable experience in the industry."



Jacob Upton said, "In addition to studying Mechanical Engineering with a concentration in HVAC&R at Cal Poly SLO, I am the president of the ASHRAE student chapter, and


the Vice President of the Cal Poly Sales Engineering Club. My involvement in these organizations has greatly aided in my career projection, and have proved very valuable.


"After spending my previous three summers interning in the HVAC industry I have transitioned into refrigeration to obtain a different view. Previously I have held roles in chemical water treatment sales, HVAC Sales with a manufacturer's representative, and project management with an HVAC design-build contractor. This summer, working for the manufacturer's representative Air Treatment Corporation in the Los Angeles office, I have been able to dive into the refrigeration industry; and have really grown to love it. The diverse product and system application present in the industry has excited me to pursue a career in industrial refrigeration."

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Reducing the Regulatory Burden with Low Charge

With federal regulatory requirements becoming increasingly restrictive in recent years, end users in the ammonia refrigeration industry have been searching for more optimal refrigeration technology that reduces the regulatory burdens, enhances safety and improves overall energy efficiency.

In an effort to meet those needs, Evapco, a Maryland-based designer of ammonia refrigeration equipment and systems, has developed a low-charge ammonia package system, called Evapcold. The first two units were installed in June at a 30,000-square-foot freezer facility in Ogden, Utah.

Unlike traditional stick-built ammonia systems, the low-charge ammonia package units use less than five pounds of ammonia per ton (lbs/TR). Each 70 TR package at the Utah facility contains only 290 pounds of ammonia for a total charge of 580 pounds for the two units. By comparison, a traditional stick-built field-erected ammonia system contains 3,500 pounds or more of ammonia.

“The lower quantity of ammonia was the driving force behind this product because of regulatory pressures,” said Kurt Liebendorfer, vice president at Evapco. “First, this is safer because you’re using

less ammonia. In designing and building the system, we paid attention to the codes and regulations, including IIAR standards, along with the operator, human safety and off-site benefits of low-charge.”

One of the lessons learned during extensive research and development was the importance of finding the proper balance of how much ammonia to remove from the low-charge unit while maintaining the required reliability and performance, which was affected when too much ammonia was removed. It was determined that two to five pounds per ton of ammonia is a suitable range for the various model sizes applied to freezer applications. “That is where we found the correct balance of reducing the ammonia significantly but still retaining the right amount to effectively deal with the difficult operating conditions that industrial systems are expected to handle,” Liebendorfer said.

Using these guidelines, the units were able to handle varying conditions, such as convertible rooms, and perform hot and cold starts and temperature pull-down while providing essential liquid management and compressor protection. In the case of the Utah facility, the unit was started in June, when the ambient temperature was 100 degrees. The units ran at 45-degree room temperature for one month while



construction of the building was completed, at which time the units then easily pulled down the freezer to minus-10 and also minus-20 degrees.

“The system is able to pull down the building in a hot-start condition because the units have a robust liquid management system for that scenario,” Liebendorfer said. “This also represents the ability of the units to reliably and automatically restart after a power outage.”

The water-cooled system also maximizes energy efficiency with variable frequency drives (VFDs) on all motors. Because the system is entirely self-contained, energy consumption can be measured at the main power feed. Energy management software is also part of the control system. The Utah facility is saving 20 percent annually in kilowatt consumption compared to a baseline stick-built installation of a single-stage economized recirculated liquid ammonia system.

In addition, each unit’s screw compressor utilizes a VFD to provide superior part-load efficiency that improves overall system efficiency. Optional VFDs on the evaporator fans have also

CASE study

been shown to improve efficiency when running below maximum capacity. Each unit is rated at 60 TR for peak conditions but is capable of providing 70 TR at maximum capacity by speeding up the compressor to 4,000 RPM.

Energy efficiency was enhanced by eliminating the long piping runs found in typical ammonia systems, which cause pressure and temperature losses and the compressors to operate at lower suction temperatures. The package units reduced these pressure and temperature losses because they eliminate the long piping runs and are internally piped. This also means that the compressors correctly run at their design suction temperature.

The case study showed a third benefit through reduced installation costs. The low-charge ammonia packages are internally piped, insulated and wired, which reduces labor required for refrigeration and electrical contractors. The packages also eliminate the cost of constructing or expanding the central machinery room. “The machinery room is part of the package design. The rule of thumb for the building cost of an average, traditional machinery room is \$1 million, so that savings can be passed on to the facility owner,” Liebendorfer said.

Liebendorfer noted that the savings is optimized if the architect designs the facility properly for these new packaged systems. The general contractor must also account for the additional roof weight of the package units in the design of the building’s structural support

steel. A package of this size requires more localized roof support than traditional stick-built installations, but if this is accounted for in the building design the cost impact is minimal. It should also be noted that one size does not fit all; Evapcold units cover spaces from 5,000 to 35,000-square-feet per unit.

“What this will mean for the ammonia refrigeration industry is a growth in applications where these low-charge ammonia packages can be installed in food and beverage processing facilities using different versions and configurations,” Liebendorfer said.

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Policy Changes Pave Way for HFC Reductions

iiar government

RELATIONS

BY LOWELL RANDEL, IIAR GOVERNMENT RELATIONS DIRECTOR

The use of hydrofluorocarbons (HFCs) has recently been at the center of policy deliberations in the United States and globally. Many HFCs used in refrigeration have high global warming potential (GWP) and have become the target for reductions by the U.S. Environmental Protection Agency and the over 170 countries that are parties to the Montreal Protocol.

The U.S. Environmental Protection Agency (EPA) is continuing its efforts to restrict the use of HFCs through amendments to the Significant New Alternatives Policy Program (SNAP). On September 26, 2016, EPA published a Final Rule that changes the list of acceptable refrigerants for various uses, including industrial refrigeration.

The EPA action comes as a part of President Obama's Climate Action Plan (CAP), which set the goal to reduce emissions of HFCs both through domestic policy changes and through multi-lateral agreements such as the Montreal Protocol. The CAP specifically identifies the SNAP program as a mechanism to encourage private sector investment in low-emissions technology by identifying and approving climate-friendly chemicals while prohibiting

certain uses of the most harmful chemical alternatives.

Through the SNAP program, EPA lists substitute refrigerants as acceptable, acceptable subject to use conditions, acceptable subject to narrowed use limits,

The U.S. Environmental Protection Agency (EPA) is continuing its efforts to restrict the use of HFCs through amendments to the Significant New Alternatives Policy Program (SNAP).

or unacceptable (prohibited) for specific uses. SNAP program rules require EPA to prohibit the use of a substitute where EPA has determined that there are other available or potentially available substitutes that pose less overall risk to human health and the environment.

As part of its evaluation of substitutes, EPA considers many criteria, including flammability or toxicity, as well as potential environmental risks such as global warming potential (GWP). This has led EPA to target the use of HFCs, many of which have high GWPs. As a natural refrigerant with no GWP, ammonia is qualified as an approved substitute.

The Final Rule published in September 2016 places restrictions

on a number of HFCs currently used in industrial refrigeration. As of October 26, 2016, new cold storage warehouses will not be permitted to use Propylene (R-1270) or R-443A as refrigerants. By January 1, 2023,

new cold storage warehouses and retail food refrigeration (refrigerated food processing and dispensing equipment) will not be permitted to use: HFC-227ea, R-125/290/134a/600a (55.0/1.0/42.5/1.5), R-404A, R-407A, R-407B, R-410A, R-410B, R-417A, R-421A, R-421B, R-422A, R-422B, R-422C, R-422D, R-423A, R-424A, R-428A, R-434A, R-438A, R-507A, and RS-44 (2003 composition). The inclusion of R-134a, R-404A and R-507A are of particular note, as these have been adopted by some industrial refrigeration facilities during the transition away from R-22.

In addition to restricting HFC use, the SNAP Final Rule also made some additions. Most notably, EPA is listing propane

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as acceptable, subject to use conditions, as a refrigerant in new self-contained commercial ice machines, in new water coolers, and in new very low temperature refrigeration equipment. EPA is also exempting propane in these end-uses from the venting prohibition under Clean Air Act (CAA). The CAA allows EPA to exempt specific refrigerants from the venting prohibition where EPA finds that it does not pose a threat to the environment.

While the EPA has been making unilateral changes to the United States HFC policies, the parties to the Montreal Protocol have been working to advance a multilateral agreement to curb global HFC use. The Montreal Protocol, which has been signed by over 170 countries across the globe, has been successful in addressing ozone depleting substances such as the refrigerant R-22. However, the inclusion of HFCs in the Montreal Protocol to address global warming has been the subject of heated debate for several years. Developing countries including India and China had expressed concerns about transitioning away from HFCs too quickly for their respective economies to adjust.

There was a breakthrough in late 2015, when an agreement was reached in Paris to develop a pathway for addressing HFCs during 2016. The Paris Agreement established the goal to keep global warming below 2 degrees Celsius, compared with pre-industrial levels. An important component of meeting

this goal is the global reduction in HFC use. According to a 2015 study by the Institute for Governance and Sustainable Development, the elimination of HFCs could reduce global warming by 0.5 degrees by 2100.

The Paris Agreement led to a series of meetings in 2016 that culminated with a summit in Kigali, Rwanda in October 2016. Participants in the Kigali

While the EPA has been making unilateral changes to the United States HFC policies, the parties to the Montreal Protocol have been working to advance a multilateral agreement to curb global HFC use.

meetings agreed to a framework that would begin a global phase down of HFC use.

Below is a summary of the dates and targeted rates of reduction in HFC use:

Developed countries, including the United States, Japan and European Union (EU), must reduce their use of HFCs by 10 percent by 2019 from 2011-2013 levels. By 2036, HFC use must be reduced by 85 percent. (It is worth noting that the EU established its own policies and targets for the reduction of HFC use in 2015.)

Developing countries would be separated into two groups. The first group, including China and African nations, must begin their

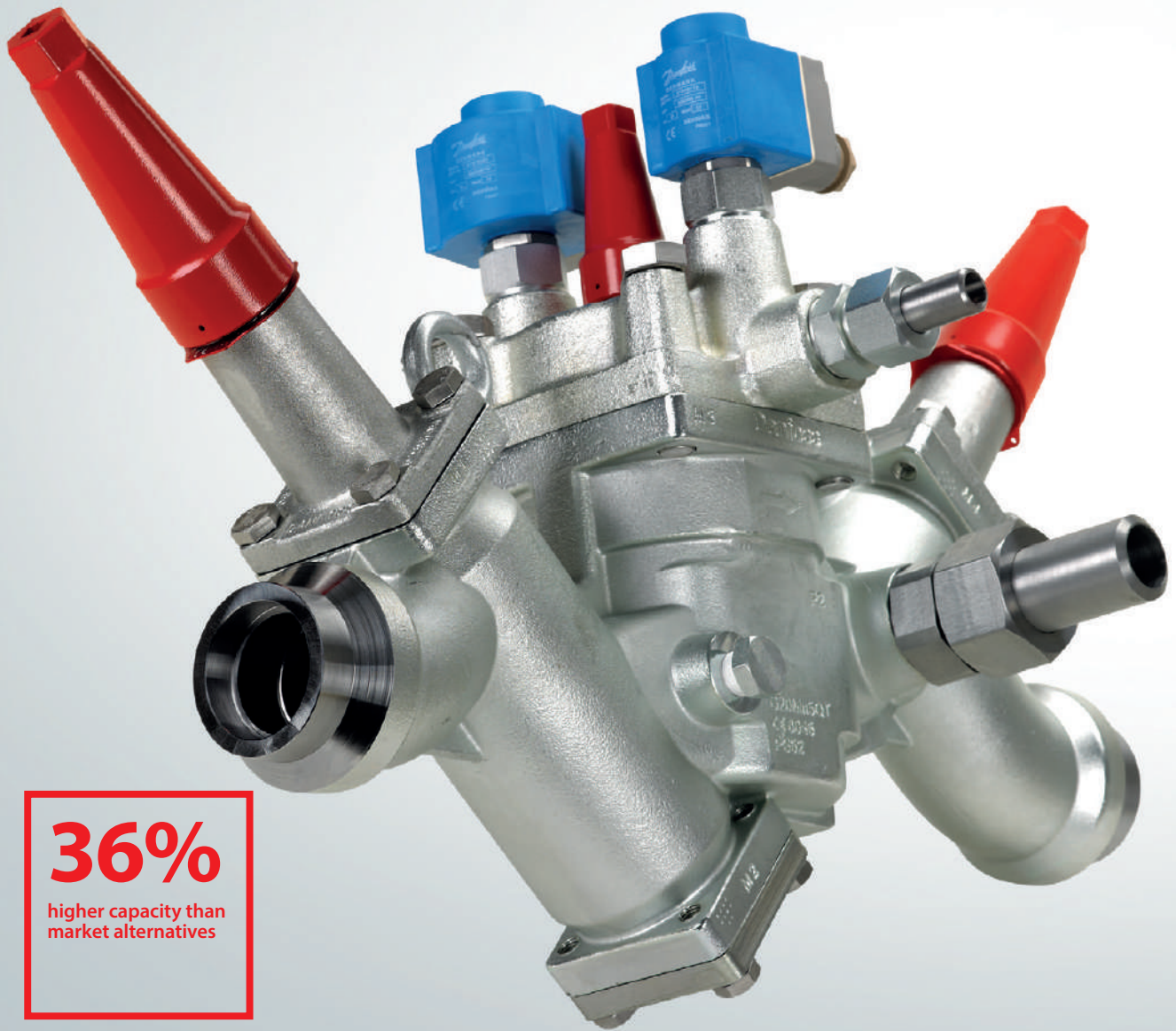
transition away from HFCs in 2024. By 2029, these countries must reduce HFC by 10 percent compared with 2020-2022 levels. HFC use would be reduced by 80 percent by 2045.

The second group of developing countries, including India, Pakistan, Iran, Iraq and Arab Gulf states, must begin the transition in 2028 with a 10 percent reduction required by

2032, based on 2024-2026 levels. This group of countries would need to achieve an 85 percent reduction in HFC use by 2047.

The recent policy changes by the EPA to further restrict the usage of HFCs and the signing of the Kigali Agreement signal important opportunities for the increased adoption of natural refrigerants. As the phase down of HFCs continues in the United States and abroad, the interest in natural refrigerants including ammonia and CO₂ will continue to grow and the development of new technologies for lower charge and package systems will give companies even more options as they transition away from HFCs.

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Maintaining the Contractor, End User Relationship

Building and maintaining a strong relationship between the contractor and the end user of an ammonia refrigeration facility is one of the most valuable things both parties can do for project success. Communication, organization and a detailed understanding of what each side offers are essential ingredients for a smooth and beneficial partnership.

Contractors outlined and discussed five principles contractors and end users can apply to get the most of their relationship . . .

Before a project begins, the contractor should clearly understand the end user's long-term plan.

"As a contractor, we need to define our customer's goals by asking the right questions to understand their budget restrictions and assemble the proper design," said Bill Sauer, sales engineer at Refrigeration Design and Service, Inc., Fairless Hills, Pa. "You need to understand their business plan regarding their short and long-term goals."

For example, he said, if the end user plans to sell the facility within 10 years, it might be in its best interest to install a less-expensive system even though it consumes more energy and may provide a shorter service life. Conversely, end users who are looking deeper into the future are better served by a more efficient system with a longer

service life that reduces energy and operating costs, allowing them to sell refrigerated space and process at a lower cost, increasing their profit margins.

Failure to understand the end user's goal can fracture the relationship. "There are multiple designs for refrigeration systems," Sauer said. "A contractor should evaluate what is in the best interests of the end user so he can make the most solid investment in his facility. Therefore, as contractors we need to inform our customers of all available options and the impact they each have."

Presenting the various options to the end user makes for informed decisions on both sides. For example, two systems that cool the facility to the same temperature might perform differently. The first may have a smaller up-front cost, but is less efficient, while the second design, although initially more expensive, could provide energy savings. Identifying the return-on-investment to the end user will help determine the length of time needed to recover the added expense of a more costly system.

"Each side needs to be upfront and honest about what they are looking for and what they can provide," Sauer said.

A long-term relationship is beneficial to both sides.

If equipment is sold and installed under warranty and the end user later hires different contractors to handle preventative maintenance, the warranties



could become null and void. Furthermore, a new contractor will not know the history of the equipment or be part of the management of the system.

"The end user will get a better bang for their buck when they have a long-term relationship with the contractor because the contractor will be more knowledgeable about the facility's equipment, the system operations and expectations," Sauer said.

The contractor and end user should work together to manage documentation and compliance requirements associated with the refrigeration system.

It is imperative that the installing contractor maintain and update all process safety management regulatory and required compliance documents so that they provide an accurate depiction of the refrigeration system. The end user plays a valuable role in this process by maintaining a library, a check-list and an organized set of close-out documents when a project is completed. This will ensure that any audit, whether in-house or by a government inspector, is thorough and accurate.

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RECOMMENDED practices

The end user should maintain and document a PSM program so that it is easy to track all work in the event of an Occupational Safety and Health Administration audit. “It’s important to have one contractor working with the facility so that this documentation is being presented in the proper format,” said Kevin Thomas, director of project engineering at RD&S. “OSHA not only wants to walk through a facility, but also wants to see all the owner’s documentation and make sure it is both accurate and complete”.

Contractors should be intimately familiar with the end user’s system in order to provide a timely response to service calls and emergencies.

“The more we know the plant system, the more effectively we can satisfy the end user’s needs,” Sauer said.

By maintaining a close working relationship, the contractor is able to respond quickly to a service need or to an emergency, mitigating down time and cost for the end user. That familiarity with the system also enables the contractor to recommend new products that will benefit the end user. “Because we know what is in place, we can recommend a new product that will provide savings on energy or mitigate maintenance costs.”

End users should work with the contractor to establish a preventative maintenance program.

The execution of a monthly preventative maintenance program

ensures that the refrigeration system is operating properly. It also benefits the end user when hiring new employees, who can then utilize the contractor to provide training on equipment, safety procedures, start-up and shutdown, and the best way to safely isolate components.

A solid relationship between the end user and a good contractor allows both parties to continue specializing in what they do best. The end user can focus more on the business and the contractor can continue to provide the end user with a well maintained, efficiently running system.

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Six Things to Remember

Installation of an ammonia detection system is an essential element in preserving the safety of employees and products at any cold storage or processing facility, along with that of residents within close proximity. Ammonia leaks must be spotted quickly and efficiently, which means that sensors must be properly installed and maintained, and possess an adequate detection range that meets the needs of the facility.

While detection systems offer a means to monitor and quickly initiate automatic responses, the human nose remains one of the most reliable and sensitive means of detection. Humans can typically detect concentrations of 5 parts per million or less. This is generally recognized as one advantage of ammonia. Not only can people easily detect ammonia, they will naturally avoid it, whereas they might not be aware of other gases and chemicals that can displace air before anyone is aware of an issue. In recognition of this sensitivity, IAR 2-2014 permits alternatives to fixed detection and alarm equipment in rooms or areas that are continuously occupied, when approved by the authority having jurisdiction (AHJ). Readers should refer to the standard for more detail.

Machinery (engine) rooms must either be provided with ammonia detection to activate emergency exhaust fans or must have continuous ventilation. Furthermore, machinery rooms must be equipped with a detection system that will shut off certain machinery and close automatic valves if the room

reaches 40,000 ppm or the upper limit of the detection system, whichever is higher.

But in most facilities, at least one detector is necessary in each room with refrigerating equipment. Considering this, there are six key points that every ammonia refrigeration facility should keep in mind regarding ammonia sensors and detection systems.

LOCATION, LOCATION, LOCATION

The industry continues to debate what is the best location to mount sensors. Ammonia vapor leaks will normally rise to the ceiling because the vapor is lighter than air, although a liquid leak will drop to the floor and can result in high concentrations on the floor and low concentrations at the ceiling. Many people believe that for the protection of people, the sensor should be placed five feet off the floor to provide a sample of what they are breathing. Sensors should be installed at spots where they are easily accessible for maintenance.

For many years, sensors were mounted on the ceiling to be near the evaporator coils. This was largely because they were capable of detecting an ammonia leak only at 150 parts-per-million. “So you had to be really close to the leak to catch it,” said Brian EuDaly, vice president of engineering at Calibration Technologies, Inc. “But now they can detect a leak at 25 ppm. Sensors mounted on the ceiling aren’t maintained as regularly, and if you ignore a sensor it might not function properly when you really need it to.”

In low-charge small package systems, the location of ammonia is concentrated in one



spot, which makes placement of the sensors more efficient and straightforward.

TAKE THE TEMPERATURE

Sensors should be designed to accommodate the environment. “The cold storage and food processing industry has very low temperatures, along with washdown and sanitation concerns,” EuDaly said. “You have to be certain that the equipment can handle the environment.”

Sensors placed in coolers and freezers should always be within a heated enclosure so that they will continue to respond properly to the presence of ammonia. “The sensor may not work if the temperature is minus-40 and it doesn’t have a heated enclosure,” EuDaly said.

DETERMINE THE SET POINT BEFORE SENSOR RANGE

Selecting the appropriate sensor ranges for your facility is another essential point. But it’s also vital to understand that sensor range and the alarm set point go hand-in-hand. “We see people install a sensor with a range of 0 to 1,000 ppm with a set point of 25 ppm. But the sensor just won’t be as accurate at that low level as one with a range of 0 to 100 ppm,” EuDaly said. “The first question to be answered when selecting a sensor range is: ‘What is the alarm set point going to be?’”

Under IIAR 2-2014 requirements, set points must be at 25 ppm in any part of a plant where there is ammonia. "In order to achieve the best accuracy, you should use a 0 to 100 ppm sensor range. In an engine room where you need 25 ppm and 150 ppm set points, a 0-250 ppm range makes sense," EuDaly said.

CALIBRATION COUNTS

An untested safety system only takes a few years to become a non-working safety system. To be certain that the sensor is accurately responding to the ammonia, sensors should be calibrated every six months. "Some sensor technologies can lose their sensitivity over time, so you need to adjust that sensitivity back to where it originally was set," EuDaly said.

CHOOSING THE RIGHT TECHNOLOGY

Emerging technology has allowed for a variety of choices when selecting sensors and alarms. For example, electrochemical gas sensors are needed for best accuracy when an alarm is at a 25-ppm set point. For high-range sensors that are placed in engine rooms, it is best to use catalytic bead or infrared sensors, which are reliable, long-lasting and free from interference gases.

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ENGINEERING YOUR SUCCESS.

IIAR Unveils Educational Certificate Program

IIAR said it has officially launched its new educational certificate program that provides industry training as well as an unbiased means to validate what participants have learned. The program started with training on IIAR-2, the latest IIAR standard to be updated, and will expand to cover additional IIAR standards and other engineering courses.

The certificate program will allow design engineers, installers and responsible parties show they have documented and standardized training for ammonia refrigeration systems. The certificate program will enable end users, designers and manufacturers to demonstrate their comprehension of the standards and other engineering safety elements. Which is particularly useful when regulators visit a facility.

“We have visited the Washington D.C. headquarters for OSHA and the EPA and found both regulatory agencies to be very receptive to our efforts to document the attainment of essential knowledge,” said Mark Stencil, IIAR chairman and director of business development at Bassett Mechanical.

OSHA’s standard on Process Safety Management of Highly Hazardous Chemicals (1910.119(g)) requires that employers provide workers who use, store, move, manufacture and handle chemicals with training on those chemicals’ hazards.

Employers must also implement written operating procedures that provide clear instructions for working safely with these chemicals. “Certainly, in discussions with regulators, being able to produce a certificate documenting your knowledge of our industry standards and Recognized and Generally Accepted Good Engineering

Practice has a lot more validity than ‘I’ve been doing this for years’,” Stencil said.

The training session includes eight live webinar training sessions that run through the end of January. The first webinar for the IIAR-2 certificate program took place in September.

Each session is also recorded, so that “people can catch up at their own pace if they miss one. They can still sign up or catch up through the learning management system,” said Trevor Hegg, vice president of industrial refrigeration product development at Evapco.

Testing to obtain the certificate will take place at the annual IIAR conference in February.

Going forward, IIAR also hopes to offer more exam opportunities at other venues throughout the year. “As this program grows, to offer exams every year at the conference would probably become a distraction at the conference,” Hegg said.

Bob Czarnecki, chairman of the IIAR standards committee and one of the major contributors to the IIAR-2 training program content, said more than 90 people took part in the first webinar.

Mark Stencil, IIAR chairman, said the first sessions have gone very well. “The slides have been professionally prepared and supplemented by field images provided by our members,” he said, adding that speakers have largely volunteered from the IIAR-2 development committee, ensuring strong subject-matter experts are covering the material.

Participants have asked good questions during the presentations and those questions have been routed to the Standards Committee for review and formal, thoughtful response, Stencil said.

The training on IIAR-2 is just the beginning. The IIAR board’s latest strategic planning session concluded with a consensus that the next phase would include a combined program for IIAR-4, IIAR-5 and IIAR-8, as well as a parallel development covering PSM/RMP material. Stencil said the standards collectively cover installation, start up, commissioning and decommissioning of closed-circuit ammonia refrigeration systems, which is “essentially a cradle-to-grave view of the installation process.”

Hegg said IIAR’s Education Committee has created a Certificate Program Subcommittee that will be working to get more people involved in the process. “That includes finding developers, content reviewers and people to draft exam questions. They’ll also take care of the planning of future programs,” Hegg said. “This ensures the material being created is accurate and valuable.”

Because the program provides a structured means for education as well as an unbiased means for interested parties to prove their knowledge, one of the goals is to allow participants to receive credit for continuing education hours if they are required to complete them.

Hegg said the committee is currently laying out a global picture for what the program will eventually evolve into. “We’re looking at all standards and documents IIAR offers and looking at having different branches of specialties,” he said. “You could have basic knowledge, operator knowledge or master knowledge. It offers the membership an opportunity to focus where their primary function is in their daily life.”

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Kigali Agreement Sets International HFC Phase-Out Schedule

More than 170 nations meeting October in Kigali, Rwanda, adopted a landmark agreement to incorporate a mandatory phase-down schedule for hydrofluorocarbon (HFC) refrigerants.

As the world's leading advocate for the use of ammonia and other natural refrigerants, the International Institute of Ammonia Refrigeration has long promoted the environmental benefits of natural refrigerants, and is positioned to become a major participant in the globalization of environmentally safe and energy efficient refrigeration systems.

The global accord reached in Kigali amends the 1987 Montreal Protocol and establishes a legally binding schedule for participating countries to cap and phase down the use of HFCs in favor of more environmentally friendly alternatives. The phase-down in the United States and the European Union will begin in 2019, with most developing countries following suit between 2024 and 2028. By 2050, this reduction in HFC emissions will be equal to 80 billion tons of carbon dioxide, which is projected to avoid approximately one degree Fahrenheit of global climate change.

“The effort to include HFCs

with the Montreal Protocol has been talked about for a number of years,” said Lowell Randel, director of government relations for IIAR. “It’s encouraging to see the agreement that was put in place in Kigali that takes this next step forward. From a natural refrigerant standpoint

growth in certain developing countries until 2050.

“It will not have a significant short-term impact on high GWP [global warming potential] HFC consumption, since developed countries have their national or regional regulations on high GWP HFCs, and the freeze for

By 2050, this reduction in HFC emissions will be equal to 80 billion tons of carbon dioxide, which is projected to avoid approximately one degree Fahrenheit of global climate change.

it is important, because as we see companies and facilities transition away from HFCs, the natural refrigerants will be one of the first places they stop. The Kigali agreement is a game-changer as far as moving from synthetic to natural refrigerants.”

Lambert Kuijpers, co-chair of the United Nations Environment Program’s Technology and Economic Assessment Panel, said the Kigali accord is “a significant step forward,” but he added, only “in so far that it has set freezes in consumption and production in specific years for developed and developing countries, which means that there will be no unlimited

developing countries is still eight to 12 years away,” Kuijpers said. “It will become significant for countries that are gradually transitioning to low GWP HFCs in particular, probably much faster than the schedules that have been adopted.”

The 1987 Montreal Protocol, designed to protect the earth’s ozone layer, banned ozone-depleting chlorofluorocarbons (CFCs) through a timeline phase-out schedule. As a result of the CFC refrigerant phase-out, many varieties of HFC refrigerants were developed. But HFC refrigerants, while ozone-friendly, trap heat in the atmosphere and contribute to

global warming. The GWP of HFC gases is considered to be several thousand times greater than carbon dioxide.

The shift away from HFC refrigerants is expected to accelerate the use of natural refrigerants with zero-to-low ozone depletion and global-warming potentials. “All countries have committed to cut the production and consumption of HFCs by 80 to 85 percent,” EPA spokesperson Melissa Harrison said. “This is equivalent to avoiding more than a decade of greenhouse gas emissions from the entire U.S. economy.”

The European Union banned the use of HFCs in automobiles several years ago, while numerous global food and beverage suppliers have moved away from using HFCs in refrigerated vending machines.

“I think there is an opportunity for natural refrigerants to be considered a really strong option,” said IIAR president, Dave Rule. “Ammonia, which has zero global warming potential, is a natural refrigerant where they know that it won’t be impacted down the road by the Montreal Protocol, the Kigali agreement or changes to the [EPA’s] SNAP program.”

The trend toward small-charge and packaged systems will also benefit the ammonia industry, Randel said. “As people take HFCs off-line, they will be deciding where to go next,” he said. “If they turn to another synthetic, there is a concern that it might end up on the list of refrigerants that will be phased down or phased out. In the past, some people

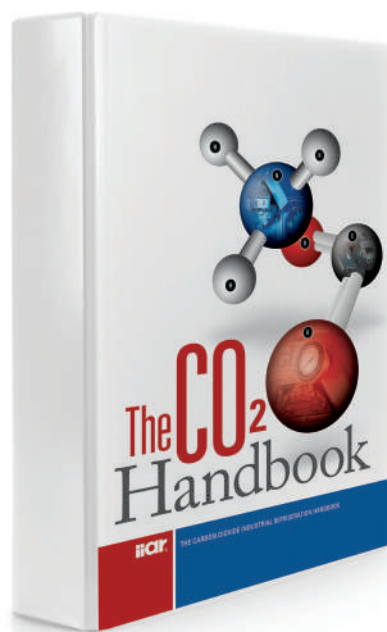
might have been more hesitant to adopt ammonia because of the regulatory burdens, but with the trend toward smaller charge and packaged systems, coupled with moving away from HFCs, it leads people to see ammonia as a viable option. End users can use ammonia with a lower charge and not have as high a regulatory burden. That combination points to a positive scenario for ammonia in the long term.”

Chemical companies that manufacture refrigerants have been developing low ODP (ozone depletion potential) and low GWP alternatives to HFCs in anticipation of mandated HFC phase-outs. However, natural refrigerant

alternatives such as ammonia, CO₂ and hydrocarbons are widely available and have a proven track record of safety, energy efficiency and environmental friendliness. In fact, only ammonia has zero ODP and GWP.

“As countries begin to phase-down their use of HFCs across a range of sectors, it will be important to identify more sustainable alternatives, which could include ammonia for specific end-uses,” Harrison said. “We anticipate seeing innovative companies introduce new products for applications where ozone-depleting substances and high-global warming potential HFCs were traditionally used.”

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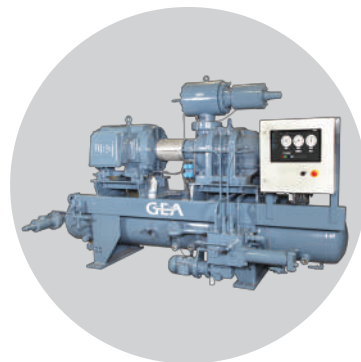


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