iiar® THE OFFICIAL MAGAZINE OF THE AMMONIA REFRIGERATION INDUSTRY ■ AUGUST 2013

CONDENSER

The Standard for Tomorrow

HANSEN
Look to the Leader in Industrial Refrigeration

URGENT PRODUCT SAFETY NOTICE – IMMEDIATE ACTION REQUIRED

June 21, 2013

Hansen recently discovered that certain pressure relief valves sold to our customers for industrial use from February 16, 2011 to April 4, 2013 are more susceptible to internal corrosion when exposed to standing water inside the valve. Even though the risk is remote, the failure of a pressure release valve could conceivably result in serious personal injury and/or property damage. Consequently, Hansen has initiated a program to send replacement valves so that any valves currently at risk can be replaced promptly. Hansen has not received any reports to date of any valve failures that have resulted in personal injury or property damage, but Hansen is taking this action in the interest of safety and avoiding potential risks. We are therefore issuing this recall of all valves that may be potentially impacted.

Specifically, Hansen H5600A, H5601, H5602, H5600R, H5602R, and H5632R valves with serial numbers 02B11 through 04B13 are susceptible, regardless of pressure setting.

Cat.No.: H5600A, H5601, H5602, H5600R, H5602R, and H5632R

Date Code OR Serial No: 02B 11 through 04B 13
Refer to sales drawing 4000-29 (Nameplate Detail, H56XX Relief Valve) for more details

If your valves have any of the serial numbers noted above, please contact your service provider, contractor or company from which you have purchased these valves. If you have distributed the above-referenced valves to other parties, please forward this notice to those parties promptly so that they can take the steps outlined in this notice. This recall does not apply to H5613, H5604, H5633R, H5634R and EZ-SRV relief valves.

# # #

Revision - July 5, 2013

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IIAR-2: The Standard for Tomorrow

In 1974, the International Institute of Ammonia Refrigeration issued IIAR-2, a standard that would uniquely address the design and installation of ammonia refrigeration systems for the first time and establish IIAR as the standards writing body dedicated exclusively to ammonia refrigeration. Now, 40 years after it defined the scope of the ammonia refrigeration industry, IIAR-2 is poised to take on an equally revolutionary role, to shape the future of ammonia refrigeration.

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TECHNICAL CORNER:

Natural Refrigerants Meet Global Warming Challenges

As the search for sustainable technologies intensifies, ammonia and other natural refrigerants are emerging as the most viable solutions for industrial refrigeration, thanks to international treaties that put pressure on countries to phase down CFCs and identify alternatives. At the same time, advances in system design are expanding the applications for ammonia systems around the world.

chairman's MESSAGE

BY BOB PORT

Summer is typically a time to kick back, relax, and ease up on responsibilities – but that's not the case for our organization this year. As I continue transitioning to my new role as chairman, I am continually impressed by the whirlwind of important projects taking place at headquarters.

Currently, all hands are on deck to complete several initiatives. One of the most notable: The revision and rewrite of the *Carbon Dioxide Industrial Refrigeration Handbook (the CO2 Handbook)*. Two years ago we charged IIAR's CO2 Committee with updating the handbook, which was originally published about a decade ago, to reflect the most recent safety and operations standards available. Today, the updated version is nearly complete.

The first individuals to recieve the final product will be the nearly 300 IIAR members who attended our CO2 workshop in Colorado Springs, Colo., earlier this year. We promised attendees we would provide the handbook at the conference, but had to delay its release due to the wide scope of work the update entailed. To ensure conference attendees receive the handbook as soon as possible, we will send sections of the document to them as we complete them, rather than waiting to release the handbook until the entire project is completed. For non-conference attendees interested in accessing the new handbook, we will begin accepting orders shortly. Our goal is to have the entire handbook completed by 2014.

While we are moving full speed ahead to complete the CO2 handbook, at headquarters we are also focused on completing and releasing the IIAR-2 ammonia refrigeration standard. The release of this standard, which we update and re-release every five years, is critical to the ammonia refrigeration industry because it establishes a comprehensive framework for all of our other standards. As part of the revision, the IIAR-2 will include updates relating to minimum safety requirements for equipment, design, and installation of closed circuit mechanical refrigeration systems using ammonia as a refrigerant.

A wide variety of committee members, volunteers, and consultants are involved in the IIAR-2 update and release, and that wide variety of perspectives is helping ensure we create the best resource possible.

But it's not just our CO2 Committee and the committees involved in the IIAR-2 rewrite that are working hard on special projects. The Safety Committee is working with the *Ammonia Safety Training Institute* (*ASTI*) to create a new ammonia safety video; the Education Committee is working on a variety of training materials and scholarship programs; the Standards Review committee is creating a new suite of standards for the industry; the Research Committee is working to identify important research topics; the Marketing Committee is spreading the word about IIAR and the value it provides the industry, the International Committee is determining how to raise the bar around the world when it comes to safety and operations of ammonia refrigeration systems; and the government relations committee (our newest committee) is creating new partnerships with government officials and spreading the word about the challenges and opportunities we face as an industry.

While each committee is focused on different initiatives, collectively they are making the ammonia refrigeration world safer by ensuring all of us have access to the best resources available.

While each committee is focused on different initiatives, collectively they are making the ammonia refrigeration world safer by ensuring all of us have access to the best resources available.

At the same time it is focused on committee work, IIAR is also looking for new opportunities to grow as a presence on the global stage, continuing to foster communication with all our international partners.

IIAR leadership is taking an active role in traveling to many industry events to represent IIAR, both here and around the world.

The ongoing support and participation of our membership makes all of these projects and opportunities possible. Thank you for continuing to enrich our industry with your collaboration, input, and knowledge. I'm looking forward to keeping you updated on the progress of these projects and initiatives, and the many others we have slated for the rest of the year. ■

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president's MESSAGE

BY DAVE RULE

Throughout this edition of the Condenser, you'll see a common theme: Progress. Over the past few months, IIAR, and the ammonia refrigeration industry as a whole, have experienced several signs of promise and growth. From gaining recognition as the go-to-resource for the ammonia refrigeration industry; to building new partnerships across the country and the world; to growing awareness that ammonia is an environmentally and economically friendly refrigerant, I couldn't be more excited about where IIAR – and the industry as a whole – are heading.

One of the most exciting signs of promise I'll point to is the rewrite of IIAR-2, the IIAR standard which governs the installation, inspection, and maintenance of ammonia refrigeration systems. The rewrite will establish the standard as the primary reference guide for ammonia refrigeration systems. The standard, which we update every five years and are currently in the midst of rewriting, provides a comprehensive framework of standards for design, operation, and maintenance of a closed loop ammonia refrigeration system.

As we work to expand and rewrite the standard, we are also working to better meet the needs of our members on a daily basis. Many have requested online access to IIAR publications and training materials. At headquarters, we are exploring various options that would enable them to purchase publications online through a subscription program.

While our publications and training materials serve as valuable resources for our members, so do our conferences. March will be here before we know it, and at headquarters, we are already preparing for IIAR's Annual Conference, which will be held in Nashville March 23 to 26. Nashville offers a central location and is easily accessible to members across the country, and around the world. We invite all to take advantage of this unique opportunity to network with the leaders in our industry.

This year's conference attendees will have a chance to hear from industry leaders, learn about the latest technology developments, and observe new products in action. The conference will also feature a heavy equipment show, and a number of major manufacturers and suppliers have already indicated they will be bringing new products and introducing new services at the exhibit hall. Safety and government regulations will also take center stage at the conference, and attendees will hear from industry experts regarding how to ensure OSHA compliance, and how to best prepare for an audit, should one head your way.

> Throughout this edition of *Condenser,* you'll see a common theme: Progress. Over the past few months, IIAR, and the ammonia refrigeration industry as a whole, have experienced several signs of promise and growth.

Despite all the exciting signs of promise happening at headquarters and across the industry, it must be said that there are still many challenges we face. A big one: safety. While safety overall has improved dramatically over the past few years, safety issues continue to crop up regularly throughout the world. Often, such issues are simply due to lack of education. That's why one of my top priorities moving forward is to continue building up IIAR's membership base, both here and internationally.

Working closely with the international committee and its chairman, Paul Bishop, the IIAR's alliance programs have continued to increase the organization's influence as we build sound relationships around the world.

These successes are a reflection of the strong involvement of our membership and a renewed enthusiasm to make IIAR the primary source of technical information, safety standards and effective advocacy for the use of natural refrigerants in industrial refrigeration.

Looking forward, I see an opportunity to continue to build on these strategic initiatives and expand the organization's leadership in promoting the safe and efficient use of ammonia and other natural refrigerants.

Meanwhile, we continue to work with the new government relations committee, pursuing a number of new initiatives designed to strengthen our advocacy programs and ensure that IIAR members are informed of pending legislation and trends in government activities as they develop.

The more individuals we can reach, the more knowledge we can share and spread throughout the world. I'm look forward to seeing IIAR grow in the coming months, and to seeing our industry continue to expand in positive ways thanks to the hard work of our members. ■

IIAR Standards Committee Pursues Organization's Goals

One of the biggest missions of the International Institute of Ammonia Refrigeration is to provide standards that will benefit the ammonia refrigeration industry worldwide.

In this edition of the Condenser we're shining the spotlight on the work of the IIAR Standards Committee, which develops, updates, and publishes current and comprehensive standards that members across the industry can trust.

To that end, the committee has taken on a huge project in recent years: writing and maintaining a suite of standards that serve as a comprehensive reference for good engineering practices for all aspects of ammonia refrigeration systems. "The goal for all of our standards is to publish them as American National Standards Institute, or ANSI standards," said Robert Czarnecki, Standards Committee chair, adding that this reinforces IIAR's standing as a valuable provider of information to the ammonia refrigeration industry worldwide.

"We're using these standards to replace many of the IIAR bulletins so that they become the documents for reference and requirements."

The Standards Committee, which is made up of 14 voting members and 28 corresponding members, said it hopes to complete each of the standards by October 2014.

This effort further establishes IIAR's prominence as a standards developing organization, and continues IIAR's tradition of providing standards that serve as credible and valuable resources.

The Standards Committee, which has already published four of the eight standards, is incorporating input from individuals involved in all aspects of the industry. In fact, the committee is made up of manufacturers, engineers, contractors, end-users, and academics. That broad array of individuals ensures the standards will be well-rounded and comprehensive, said Czarnecki. "It gives all the different perspectives."

The committee is also providing the public with an opportunity to share their perspectives. Upon completion of each standard, the committee releases it for public review.

"In each case, we take all the comments, rewrite the document, incorporate all the answers, and send it out for public review again," he said. "Then, the IIAR standards committee presents that work to the consensus body, which is a balanced group of experts that weigh in with final comment and approval." ■

President Obama Signs Executive Order on Chemical Facility Safety and Security

On the first of August, President Obama announced the signing of an Executive Order entitled: Improving Chemical Facility Safety and Security.

The action was in response to the explosion earlier this year at a fertilizer facility in West, Texas. A Chemical Facility Safety and Security Working Group will be formed to direct the federal government's efforts to implement the Executive Order.

The working group will be co-chaired by representatives from the Department of Homeland Security, Environmental Protection Agency and the Department of Labor. Other representatives on the working group will be from the Department of Justice, Department of Agriculture and Department of Transportation.

The Executive Order outlines four major goals to improve chemical safety and security:

- Improve operational coordination with state and local partners
- Enhance federal agency coordination and information sharing
- Modernize policies, regulations and standards
- Work with stakeholders to identify best practices

While many of the efforts undertaken in support of the order will be focused on improving how federal agencies work together and share information, it is possible that the effort will result in additional regulations impacting the cold chain industry. For example, the order states that within 90 days EPA and OSHA shall review the chemical hazards covered under the Risk Management Program and Process Safety Management and determine if either of these programs need to be expanded. EPA and OSHA would also be required to develop a plan to implement and enforce such expansions.

IIAR Government Affairs will continue to actively monitor developments regarding the Executive Order.

DHS Issues Letters to Facilities Regarding CFATS Program

The Department of Homeland Security, DHS, has recently sent a large number of letters out to facilities regarding potential non-compliance with the Chemical Facilities Anti-Terrorism Standards, or CFATS. The letters are a result of DHS engaging in an increased information sharing effort across Federal and State governments to better understand the universe of chemical facilities. They have attempted to cross match DHS facility data with that of other agencies such as the Environmental Protection Agency.

The potential non-compliance referenced in the letter stems from whether the facility filed a Top-Screen with DHS. Notwithstanding certain exemptions, facilities with a chemical of interest, COI, at a screening threshold quantity, STQ, must file a Top-Screen with DHS within 60 days of acquiring a threshold quantity of the chemical. Anhydrous Ammonia is classified as a chemical of interest and the threshold quantity is 10,000lbs. Members receiving such a letter from DHS are encouraged to review their facility history to determine whether a Top-Screen has been filed with DHS, or if the facility is exempt.

Current exemptions from the Top-Screen requirement are:

- The facility does not possess a chemical of interest at a threshold quantity
- The facility is regulated under the Maritime Transportation Security Act of 2002
- The facility is a wastewater or drinking water facility
- The facility is owned by the Department of Defense, Department of Energy or subject to the Nuclear Regulatory Commission
- The facility is an agricultural production facility subject to the current indefinite extension to the Top-Screen requirements

Facilities that have either filed a Top-Screen previously or are exempt are directed to contact DHS at Compliance. Assistance@hq.dhs.gov or IP/ISCD, Mail Stop 8100, Department of Homeland Security, Washington, DC 20528-8100 as soon as possible. Facilities with questions can call the DHS CSAT Helpdesk at 1-866-323-2957. Be sure to have your letter from DHS with you when you call.

Facilities that are not exempt and have not filed a Top-Screen should move quickly to get into compliance. The letter provides a deadline of September 9, 2013 for facilities to complete their filing. More information on the CFATS Top-Screen process can be found in the CSAT Top-Screen User Manual.

As a member of IIAR you join with over 2,000 individuals in more than 30 countries who share your enthusiasm and commitment to your career and profession. Strength in numbers helps us make a positive difference!

Advocating for You

IIAR works year-round promoting member interests before regulatory bodies including EPA, OSHA and other code-writing authorities. We unite the collective strength and knowledge of our members to ensure the safest and most efficient environment for the industrial refrigeration community.

Investing in our Members

IIIAR believes in committing to the professional and educational growth of our members. In the 2013-2014 membership year IIAR will be hosting the *2014 Industrial Refrigeration Conference & Exhibition* in Nashville, TN from March 23 – March 26 as a **Heavy Equipment Show**. Held once every three years this show debuts the cutting edge technology in industrial refrigeration. It also delivers a world class technical program, presented and peer reviewed by the best minds in the industry, IIAR members.

Scheduled for release in the 2013-2014 membership year are two IIAR Standards – IIAR 5 and IIAR 7. Dealing with the startup and commissioning of closed circuit ammonia refrigeration systems and the development of operating procedures for closed-circuit ammonia mechanical refrigeration systems respectively, these highly anticipated standards will be free to reference digitally to all IIAR members when you logon to www.iiar.org.

Return on Investment

Your membership in IIAR is a corporate investment that pays immediate dividends for you and your organization. "Sustainable enterprises must operate efficiently and safely. Actively participating in IIAR gives me the insight into how others are identifying gaps in these areas and driving their organization to not only improve but excel." Martin L. Timm, P.E., Process Safety Manager, Praxair, Inc.

When you belong to the IIAR community, your voice adds impact to our industry.

"Why am I an IIAR member? The people... "You are judged by the company you keep" and I cannot think of any better company than the members of IIAR. When you think of the great advocacy work the IIAR does for our industry, the great educational material the IIAR creates, and the "general accepted good industry practices" the IIAR develops to aid us in making our industry one of the safest in the world. All of the above and much, much more were created by the members of IIAR. I cannot think of any better reason to be a member of IIAR, can you?"

—**James C. Marrella**, Coordinator OSHA/EPA Compliance, United States Cold Storage, Inc.

"How could anyone having anything to do with ammonia refrigeration not be an IIAR member? For me, the main reason I belong to IIAR is that it is the best source of information about our industry, and that it is on the cutting edge of new development of ammonia refrigeration uses and methods."

—**Peter R. Comeau**, LEED AP, President – RECCO

If you have not already renewed your membership, just logon to **www.iiar.org** with your username, member number and password, click on **My IIAR** and select **Renew My Membership** • **iiar_request@iiar.org** • **703-312-4200**

iiar®
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Congress Considers Modernization of Chemical Security Laws

iiar® government RELATIONS

BY LOWELL RANDEL, IIAR GOVERNMENT RELATIONS DIRECTOR

The Toxic Substances Control Act (TSCA), signed into law in 1976, provides the Environmental Protection Agency (EPA) the authority to control potentially dangerous chemicals in U.S. commerce. The act gives EPA the authority to gather and disseminate information about production, use, and possible adverse effects to human health and the environment of existing chemicals, and to issue "test rules" that require manufacturers and processors of potentially dangerous chemicals to conduct and report the results of scientific studies regarding the chemicals.

Under TSCA, EPA regulates both existing chemicals and new chemicals proposed for use in the United States. For new chemicals, EPA is required to conduct pre-market screening and regulatory tracking. Should EPA determine that a chemical poses an unreasonable risk, the agency must initiate rulemaking to address such risks by regulating various aspects of the chemical from manufacturing to processing, use and disposal. TSCA applies to both natural and synthetic chemicals. Ammonia is one of the thousands of chemicals included in EPA's Chemical Substance Inventory as a part of its TSCA activities.

Since its enactment, the legislation has been amended five times to address specific chemical concerns such as asbestos, radon, lead, formaldehyde and environmental issues in schools. While provisions have been added to the statute, the core underlying provisions in TSCA have remained unchanged since 1976.

EFFORTS TO MODERNIZE TSCA

Over the last few years momentum has been growing for the modernization of TSCA. Industry groups became increasingly concerned that technological advances and additional science-based information was not being fully utilized under the old TSCA framework. Industry also was frustrated by the increased focus by states to take chemical safety regulations into their own hands creating a patchwork of regulations that are extremely difficult for companies to navigate. At the same time, consumer safety advocates have expressed concerns that antiquated TSCA regulations do not provide EPA with adequate authorities to protect the public.

In response to the debates about modernizing TSCA, the American Chemistry Council developed the following list of principles to guide the updating of the statute:

1. Chemicals should be safe for their intended use.
2. EPA should systematically prioritize chemicals for purposes of safe use determinations.
3. EPA should act expeditiously and efficiently in making safe use determinations.
4. EPA should complete safe use determinations within set timeframes. Companies that manufacture, import, process, distribute, or use chemicals should be required to provide EPA with relevant information to the extent necessary for EPA to make safe use determinations.
5. Potential risks faced by children should be an important factor in safe use determinations.
6. EPA should be empowered to impose a range of controls to ensure that chemicals are safe for their intended use.
7. Companies and EPA should work together to enhance public access to chemical health and safety information.
8. EPA should rely on scientifically valid data and information, regardless of its source, including data and information reflecting modern advances in science and technology.
9. EPA should have the staff, resources, and regulatory tools it needs to ensure the safety of chemicals.
10. A modernized TSCA should encourage technological innovation and a globally competitive industry in the United States.

With the growing recognition for the need to update TSCA, Congress has explored a number of options for modernizing the act. In 2011, the late Senator Frank Lautenberg (D-NJ) introduced the Safer Chemicals Act. The bill was approved by the Environment and Public Works Committee on a party line vote. Republicans, supported by industry, opposed the bill because they believed the legislation presented an unworkable safety standard, failed to adequately address the issue of state preemption and would put domestic industry at a competitive disadvantage on the global market.

As late as August 2013, the prospects of a bipartisan solution to modernizing TSCA seemed unlikely. However, in the weeks before his death, Senator Lautenberg began working with the Ranking Republican of the committee, David Vitter (R-LA) on a bipartisan compromise. These efforts led to the introduction of the Chemical Safety Improvement Act (CSIA) of 2013.

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Congress Considers Modernization of Chemical Security Laws

CHEMICAL SAFETY IMPROVEMENT ACT OF 2013

S. 1009, the Chemical Safety Improvement Act of 2013 was introduced on May 22, 2013 by Senators Lautenberg and Vitter along with 14 bipartisan cosponsors. The bipartisan compromise addresses the 10 principles of modernization advanced by the ACC and has received support from a broad range of industry and consumer interests groups.

CSIA would establish a new safety standard of "no unreasonable risk of harm to human health or the environment will result from exposure to a chemical substance" under "intended conditions of use." The new standard strives to achieve a balance between risks and benefits. The bill states that EPA must rely on robust scientific evidence and balance the mutual goals of promoting the safety of American consumers and preventing harm to American innovation, manufacturing, and the economy. EPA would be required to use the best available science and science-based criteria when assessing chemicals.

The legislation would require EPA to establish a process to categorize chemicals as high or low priority for safety assessment and determination. High priority chemicals would be subject to a safety assessment that would include information about potential hazards, use and exposure and vulnerable populations. Assessments would be based solely on considerations of risk. EPA would then issue a safety determination based on the intended use of the chemical. If the safety standard is not met by a chemical, EPA would be required to impose regulations to mitigate the hazards. This process would be subject to public notice and comment, adding an additional measure of transparency not found in the current process.

Another important aspect of CSIA is the strengthening of preemption rules. Under the legislation, certain EPA determinations (both retrospective and prospective) would preempt state regulations. Preemption includes EPA's designations of chemicals as high or low priority. States would have the opportunity to apply for a waiver, but that process would be more transparent, require public notice and comment and be eligible for judicial review.

STATUS AND PROSPECTS

As of July 2013, the number of cosponsors of CSIA has grown to 25 Senators with a balanced mix of Democrats and Republicans. While there is strong bipartisan support for the legislation, there are some in the Senate who have concerns with the compromise bill. Senator Boxer (D-CA), Chairwoman of the Environment and Public Works Committee, has expressed her opposition to certain aspects of the bill. In particular, Boxer does not like the strong preemption language in CSIA. California has been one of the most active states to develop its own chemical safety regulations and Boxer is reluctant to limit her state's ability to create its own set of standards.

The death of Senator Lautenberg shortly after the introduction of the bill has also complicated the situation surrounding the legislation. Lautenberg has long been the most active champion for TSCA modernization. Some speculate that his death makes it easier for Boxer to impose her desires to modify the carefully crafted compromise between Lautenberg and Vitter. Others believe that Lautenberg's death gives Senators added incentive to pass his last piece of legislation to honor his work on the issue.

The Senate is seen as the chamber leading the way on TSCA modernization. Legislation similar to CSIA has not been introduced in the House of Representatives, but it is expected that if the Senate approves the CSIA with broad bipartisan support that the House would likely bring up companion legislation.

As members of Congress contemplate the next steps towards TSCA modernization, the American Alliance for Innovation (AAI), a group of more than one-hundred trade associations representing a broad spectrum of American businesses throughout the manufacturing and distribution supply chain is rallying in support of the CSIA. The AAI coalition, led by the American Chemistry Council was formed to actively engage in efforts to better understand and address legislative and regulatory chemical management issues at the federal, state, and local levels. TSCA modernization has become a high priority for the AAI and the coalition has rallied in support of the CSIA. IIAR has recently joined AAI and has cosigned statements of support for the bipartisan compromise reflected in the CSIA. IIAR will continue to actively participate in the AAI and advocate for the implementation of a more balanced and science-based framework for chemical safety regulations. ■

ABRAVA Names New President

The Brazilian Association of Refrigeration, Air Conditioning and Ventilation, or ABRAVA, said it recently named a new president of the organization.

Wadi Tadeu Neaime was inducted as ABRAVA president in conjunction with the swearing in of the organization's new Board of Directors for 2013 to 2016, which took place on June 27 at the São Paulo Renaissance Hotel. IIAR was represented at the event by Fabrício Fernando Franco, Technical and Commercial Director of MRBraz & Associates.

Fabrício Fernando Franco (at left), Wadi Tadeu Neaime (at right).

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Dealing With Conflicting Codes and Standards

iiar code advocacy **UPDATE**

BY JEFFREY M. SHAPIRO, P.E., FSFPE

Although much effort goes into coordinating various documents that regulate ammonia refrigeration systems, perfect harmony isn't achievable for a variety of reasons. Anyone who designs or operates facilities that utilize ammonia refrigeration knows that we deal with a lot of codes and standards. These include IIAR-2; ASHRAE 15; the International fire, building and mechanical codes; the NFPA building and fire codes; and the Uniform Mechanical Code. For a little more complexity, tack on federal regulations promulgated by OSHA and EPA.

IIAR's efforts to achieve consistency among regulations face two significant obstacles. First, the different "families" of model codes and standards (IIAR, ASHRAE, International Code Council, National Fire Protection Association and International Association of Plumbing and Mechanical Officials) and federal regulations are all developed using different processes. It's not uncommon for these different processes to yield different results even when the initial text of recommended changes may have been the same.

Likewise, each code and standard development process involves different individuals and organizations in the decision making that determines the final regulations. Because these individuals, their experiences and the perspectives that they represent differ, regulations that they generate will differ as well.

Each code and standard development process involves different individuals and organizations in the decision making that determines the final regulations. Because these individuals, their experiences and the perspectives that they represent differ, regulations that they generate will differ as well.

On occasion, designers will encounter situations where they are expected to comply with multiple regulations from different documents that are not consistent. In addition, you can sometimes encounter situations where different sections of the same code specify different requirements. When that happens, it can be a source of frustration trying to decide how to satisfy the competing requirements, so here is some guidance to consider.

Let's start at the top. Federal law trumps all other laws and regulations, and federal fines can be orders of magnitude higher than local fines. However, in the case of EPA and OSHA regulations, these regulations tend to focus on facility operation rather than initial design. Accordingly, conflicts with Federal law don't tend to be an issue for initial design of a facility, and the focus for design will be compliance with local building, fire and mechanical codes and industry design standards, such as IIAR 2. So, how do you deal with conflicts among these documents?

Contrary to popular belief, the answer to that question is NOT "follow the most restrictive requirement." Instead, there are two general rules, 1) codes trump standards, and 2) within a single code, specific trumps general. These two rules are specifically spelled out in all model code documents, which are typically adopted as the basis of regulating design and construction of buildings and refrigeration equipment by state and local jurisdictions.

As an example of the text that specifies how to deal with conflicts, the 2012 International Fire Code states in Section 102.7.1:

"Where conflicts occur between provisions of this code and referenced codes and standards, the provisions of this code shall apply."

This text makes it clear that it is the intent of the code that any requirement in code text supersedes whatever may be required by a referenced standard, such as IIAR-2, even if you believe that the referenced standard is "right" and the code is "wrong." The IFC also states in Section 102.10:

"Where there is a conflict between a general requirement and a specific requirement, the specific requirement shall be applicable. Where, in a specific case, different sections of this code specify different materials, methods of construction or other requirements, the most restrictive shall govern."

Other codes in the International code family include provisions that reflect the same approach as shown above.

The provisions in Section 102.10

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may seem a little confusing at first, but if you read them closely, what they tell you is, where there is a legitimate conflict between two sections of the same code, in this case the IFC, you follow the requirement that most specifically applies to the situation at hand. The second sentence tells you that, if there is no clear specific vs. general requirement, you follow the more restrictive provision.

You might be asking at this point, how is it possible that two sections of the same code end up conflicting with one another? I've personally seen this happen in cases where someone proposed a new requirement to deal with something that was already handled elsewhere in the code. If nobody happens to notice the conflict during the code development process, it ends up in the code. Fixing such an issue, assuming that it gets noticed, requires someone to submit a new code change proposal to the next edition. Sometimes that happens, sometimes not.

It's also worth mentioning that, in some cases, you may find two sections of a code include different requirements, but they don't necessarily conflict or have a clear "specific over general" relationship. I typically view a conflict as an inability to simultaneously apply equal requirements. Where requirements from different code sections can be simultaneously applied, consider whether it's more appropriate to satisfy both requirements vs. handling the situation as a conflict.

Like the International codes, NFPA codes, such as NFPA 1 Fire Code, and the Uniform Mechanical Code establish nearly identical provisions to those discussed above. In the case of NFPA 1 Fire Code, the issue of conflicts between codes and standards is addressed in Section 1.3.3. In the Uniform Mechanical Code, the issue is handled in Section 101.3.1.

ASHRAE 15, as a referenced standard, is pretty well correlated with the model code approach. It provides a specific deferral to codes vs. ASHRAE 15 in Section 12, as follows:

"Where there is a conflict between this standard and local building, electrical, fire, mechanical, or other adopted codes, their provisions shall take precedence unless otherwise stated in those codes."

The next edition of IIAR 2 will likely have similar text.

Of course, there may be cases where following the prescriptive rules for handling conflicts described above don't work well in the opinion of the designer, and for those cases, you always have the option of proposing an alternative method of compliance or a code modification. For advice on how alternate methods and code modifications work and how to propose them, you can review my previous article in the August 2008 *Condenser*. ■

The Standard for Tomorrow

BY ANDREA FISCHER

In 1974, the International Institute of Ammonia Refrigeration issued IIAR-2, a standard that would uniquely address the design and installation of ammonia refrigeration systems for the first time and establish IIAR as the standards writing body dedicated exclusively to ammonia refrigeration.

Now, 40 years after it defined the scope of the ammonia refrigeration industry, IIAR-2 is poised to take on an equally revolutionary role, to shape the future of ammonia refrigeration.

The role of ammonia and other natural refrigerants will continue to expand in the coming decade. As the threat of global warming propels natural refrigerants to the front of the line in the search for environmentally stable technologies and the rapid evolution of equipment expands the reach of ammonia and carbon dioxide, the forces that will shape the future are already in motion.

IIAR-2 will play an important role in translating possibility into reality by establishing the bounds for ammonia to grow or be limited.

The standard is currently undergoing a comprehensive update to reflect the industry's technological change and evolve into a single source document for the safety and design of ammonia refrigeration systems.

"We're writing this standard for tomorrow, not today," said IIAR President Dave Rule. "By looking at where we're going to be as the industry changes, we can create a standard that meets our needs now and in the future."

Creating such a standard will require IIAR-2 to provide much more information than its previous versions, while at the same time becoming more focused.

"We're trying to incorporate all the aspects of safety we can, to capture as much information as we can, so that we will be able to consider this one document the comprehensive guide to safety and design criteria across the industry," said Tom Leighty, Chair of the IIAR-2 Standard Subcommittee.

"While the current version of IIAR-2 relates to safety through appropriate design, the topic of safety was not the original focus of the standard," said IIAR Technical Director Eric Smith.

"Prior to this update, IIAR-2 was more closely focused on design standards for systems and equipment. It has not previously covered all the aspects of safety that need to be considered, such as the applications of systems – where ammonia equipment can be used and how safety standards should be applied to different applications."

While the concept may seem simple, the road ahead will be challenging, as the IIAR Standards Committee methodically works to incorporate public input and identify all the detail the updated standard should address.

The committee is currently working to meet the next 2014 publication deadline for updating the standard, which is an aggressive schedule considering the complexities of the American National Standards Institute guidelines that IIAR follows for development of IIAR standards.

"The decision to develop and administer our own regulations comes with tremendous responsibility to ensure fairness, openness and technical validity in achieving decisions that balance safety, equipment options, installation concerns, operational concerns and cost," said Jeff Shapiro, IIAR's codes and standards specialist.

"Fortunately, we have a long history with developing IIAR-2 and other authoritative documents, and I have confidence that IIAR understands the level of commitment that's required and that we're up to the task," he said.

As the threat of global warming propels natural refrigerants to the front of the line in the search for environmentally stable technologies — and the rapid evolution of equipment expands the reach of ammonia and carbon dioxide — the forces that will shape the future are already in motion.

The primary objective of the next edition of IIAR-2 is to become a consolidated source of safety information for ammonia refrigeration systems.

"Our driving force is to simplify access to good, quality information in our industry standards," said Leighty. "There's no good single source for system design and safety information right now, and that is confusing for everyone. So, we want to provide a common place to obtain that material."

"Currently, information that describes safety for ammonia systems is made up of a collection of sources, from IIAR-2 itself to other industry standards, that sometimes conflict with each other," said Leighty. "In some cases, ammonia safety requirements are presented as exceptions to general safety requirements rather than addressing ammonia as a primary refrigerant."

"That approach understates the role and importance of ammonia as a leading industrial refrigerant," said Leighty.

"With the proposed changes to IIAR-2, we're going to eliminate any question about how we, as an industry, view the importance of high quality design and safety standards," he said. "We're aiming to provide a singular approach that minimizes the need to interpret varied or competing regulations."

"Although the current system, including previous versions of IIAR-2, has served the industry reasonably well up to this point," said Bob Czarnecki, Chairman of IIAR's Standards Committee, "The time has come to take things to the next level. There are good engineering practices out there, but where are they all spelled out in one place? The answer is that there isn't any one place to go to find this information right now," he said. "We're in a situation where our industry is being described by default because we don't have one cohesive body of information that is supplied by our industry and is the recognized authority."

And that situation presents frustration and introduces unnecessary challenges for anyone trying to interpret safety guidelines for ammonia. "People have to go somewhere to get rules and regulations, and if they can't find it in one place, they have to go somewhere else," he said. "Our goal is to make IIAR-2 a singular reference standard for our industry so people don't have to go anywhere else when designing systems."

One example of the complexity of using the current system involves the relationship between IIAR-2 and ASHRAE 15, both of which are adopted as reference standards in model codes that govern building construction. ASHRAE 15 is primarily a safety standard that includes design guidance; whereas, IIAR-2 is primarily a design document that addresses some safety concerns. There are a number of places where ASHRAE 15 has to defer to IIAR-2 for ammonia systems, and there are a number of places where IIAR-2 has to defer to ASHRAE 15 for general safety requirements, Shapiro said.

"It's a challenge to figure out which document includes any particular requirement, and to design a building with ammonia refrigeration, you really need to have both documents open side-by-side to make sure that all pertinent regulations are identified and addressed," he added.

The current situation is no particular fault of IIAR-2 or ASHRAE 15, but rather a consequence of ASHRAE 15 having such a broad scope, applying to all refrigeration systems and all refrigerants in all applications, rather than ammonia specifically, said Shapiro.

The need to address ammonia specifically in all its applications has been driven in part by the advent of technology that is not yet addressed by any standard, according to IIAR's Smith.

One such technology is used by low charge, small package systems. "We're looking at how and where those systems can be used," said Smith. Addressing safety for such a system might mean providing unique provisions for ventilation systems, alarms and alarm levels, or specifying when and where detectors should be applied. "These are the kinds of things no one in our industry has addressed in detail yet," he said.

IIAR will also address a wide variety of other issues, some of which have prompted discussion within the industry over the years. Smith said IIAR-2 may revisit the question of "shunt-tripping," or the de-energizing of electrical equipment in the presence of large concentrations of ammonia, and it will likely address clarifying requirements for hydrostatic relief valves and pressure vessels. IIAR-2 will also touch on automatic controls and components, said Czarnecki.

Another major change that will be part of the IIAR-2 update will mean that IIAR removes content that is not design focused, particularly information surrounding maintenance, installation and testing procedures. "The goal for the 2014 edition is focusing IIAR-2 on safe system design and providing references to other IIAR standards that have recently been developed to address other topics that were historically covered by IIAR-2," said Smith. "For example, we're taking out specific provisions for start-up and commissioning testing procedures and will reference the newly published IIAR-5, 'Start-up and Commissioning of Ammonia Refrigeration Systems.'"

"We're very interested in expanding beyond our traditional focus on industrial ammonia systems," said Czarnecki. "Our scope, when it comes to standards has always been specifically industrial refrigeration. But now, there are many other applications for ammonia systems, and we need to incorporate those. The potential for growth of the industry is huge."

The need to address ammonia specifically in all its applications has been driven in part by the advent of technology that is not yet addressed by any standard.

Eric Smith, IIAR Technical Director

Another area where IIAR-2 may have wider reaching implications has to do with location of equipment.

Currently, codes and standards require most ammonia refrigeration equipment to be located in dedicated machinery rooms with special safety features, but interestingly, no application of ammonia other than refrigeration systems has a similar restriction.

This raises the questions of what would make ammonia in a refrigeration application uniquely hazardous versus ammonia used for other industrial processes and, if there is no identifiable unique hazard, whether it should be permissible to allow equipment, such as pumps, in process or storage areas.

"The traditional approach for ammonia systems has focused on confining all major equipment, other than evaporators and condensers, to a machinery room because of a belief that the machine room was the only safe place to put that equipment," said Shapiro. "However, improvements in equipment and safety systems have led some experts in our industry to start thinking outside of that box."

Czarnecki agreed with Shapiro, saying that it is certainly reasonable for the IIAR Standards Committee to explore new options that might provide specific rules and regulations that vary based on where equipment is located.

An IIAR-2 update may also change the way the industry interacts with OSHA and EPA.

"OSHA and EPA are looking for recognized and generally accepted good engineering practices," said Smith. "That means, for example, when OSHA comes out to inspect a facility, they can do a better job of ensuring safety if they have guidelines that are unique to our industry. We're attempting to provide them with better guidelines with the new version of IIAR-2."

In the big picture, having a clearly established basis of regulation for ammonia refrigeration systems will significantly benefit the industry and its regulators, according to Shapiro. "If everyone is provided with a clear understanding of what's expected, it won't come as a surprise when non-compliant designs are rejected for failing to meet those expectations," he said. "Having IIAR-2 as a single, comprehensive rule book for safe system design may also reduce the level of tension that is often associated with facility inspections."

As the IIAR-2 rewrite moves forward, it will undergo a comprehensive standards development process led by IIAR and governed by ANSI rules.

"This effort is at the heart of what we do as an industry standards body," said IIAR's Rule. "Our goal is to lay the groundwork for the future of this industry, and we're accomplishing that as we begin to expand the scope of IIAR-2 and the other standards that are being developed."

It's exciting to update IIAR-2," said Leighty. "It was the first standard that IIAR produced, and it was produced with the sole intention of creating design parameters so that people would utilize ammonia refrigeration safely. Now, we're going to the next level. Our standards are the foundation of our industry, and they will continue to evolve as we do." ■

Emergency Planning Should Involve Coordination with Local Responders

BY KEM RUSSELL

Coordination with local responders is a basic safety responsibility for any facility, but in some cases, even if a company has a well-articulated emergency plan, the lessons learned from a small incident can reveal much bigger considerations.

In this column, in each issue of the *Condenser*, we look at lessons learned from many different kinds of situations. Below, we examine a small release, including what causes contributed to the incident, how a response effort was handled and what can be learned about emergency planning by observing how a facility addressed communication with first responders in the midst of the event.

In the following paragraphs, we'll lay out the events leading up to and following a release, and examine the lessons learned at each stage of the response.

It was a nice evening late in the summer, and the ammonia system for a large cold storage facility had been shut down after all of the stored product had been packed and shipped.

The computer control system for the refrigeration system remained operational, primarily for the ammonia detection system that was kept active around the clock to monitor and alarm.

This facility, like many similar facilities, had many pressure vessels designed for 150 psig as the maximum working pressure. This maximum vessel working pressure was usually acceptable, since system operating suction pressure rarely reached 90 psig.

The facility had not had a complete system shutdown during the summer for several years, so although the shutdown was done as described in the standard operating procedures, an important precaution had not been considered in the shutdown procedure.

That important precaution serves as the first "lesson learned" from this scenario: when a system is completely shut-down the system pressure will begin to equalize at a pressure corresponding to the ambient temperature.

In this particular case the ambient temperature was around 75°F to 80°F. Checking the temperature pressure chart for anhydrous ammonia will reveal a corresponding pressure of 125.5 psig to 138.0 psig. The upper range of this pressure is getting into an area of concern with a 150 psig relief valve. The concern comes with regard to the possibility that a relief valve may start weeping or simply release. In this particular case, one of the 150 psig relief valves did release.

The release began at about 10 pm, and since the facility was shut down, there were no facility personnel on-site.

The alert that a problem was developing came from a person who lived close to the facility site. The person was the first one to realize something unusual was occurring, because of the very loud noise they heard coming from the facility.

The person did not have any phone numbers for facility contacts, so they called 911. The emergency responders, in turn, did not have an established protocol for communicating with facility personnel, a factor that serves as the basis of the remaining "lessons learned" in this scenario.

Second lesson learned: establish a facility contact protocol with local emergency responders.

The fire department, which was located about two miles down a main road, responded to the site in just a few minutes. It just so happened that when the call went out from the fire dispatch, one of the facility personnel who also served as a volunteer fireman heard the call on his fire dispatch radio and quickly notified fire dispatch that he was en-route to the facility.

It would have been a considerable time before any facility personnel would have been notified if this person hadn't had an active fire radio. The fire dispatch would have had to search for a name and phone number of a facility person to call.

With the help of the facility employee, and after a quick investigation, it was determined that a relief valve was releasing from a surge drum vessel that was located outside and approximately 25 feet in the air.

Realizing that they were dealing with an ammonia release, the fire department on-scene commander asked for assistance from the local police department to close the roads near the release point. The state patrol was also notified because it was a hazardous material release.

Because the responding fire department was not trained to offensively deal with ammonia releases, they called for assistance from a neighboring community that did have an all-hazard response team. Even though the facility was part of the County Emergency Plan, the duration of the release was extended because there was no one with the knowledge, training, or equipment to "offensively" work on the problem.

The response in this case highlights the third lesson learned from this incident: make sure local responders are trained in the process of determining what resources are needed to deal with an ammonia release during its very early stages.

With no one, including the fire department personnel or the facility employee trained, or with the proper personal protective equipment to do a closer investigation, the leak continued.

In addition, there was no person on-site who was knowledgeable and experienced in ammonia refrigeration system operation, a fourth lesson learned: designate a person who can be immediately available to assist responders in considering a plan of action.

In this case, the next option was to contact one of the local refrigeration contractors for assistance.

In a short time a refrigeration technician representative from a refrigeration contractor arrived, but that person was also restricted from getting near the release point since they also did not have the training or personal protective equipment to approach the ammonia release.

However, after a short review of the operating pressures of the system, it was suggested by the technician that starting the system and lowering the suction pressure might have a desirable effect. Within a few minutes of starting the system, the suction pressure greatly reduced, dropping quickly below 100 psig, and causing the relief valve to re-seat, stopping the release.

The release duration was approximately two-and-a-half hours, during which time the relief valve never closed.

Although the release lasted two-and-a-half hours the incident itself was shut down relatively quickly thanks to some quick thinking and a quick response, but some of the main lessons learned by this incident should not be ignored.

First, all potential shutdown conditions should always be thoroughly examined, and procedures should be developed to keep system pressures below relief valve release points even during shutdown conditions. In addition, facility emergency plans should address the communication to and from neighbors in the event that an incident occurs.

Second, facilities should make sure that local responders have facility contact information readily available for key facility personnel, and that the facility has coordinated and worked with the local responders on a regular basis. In addition, that coordination should include all work shifts that the responders might have.

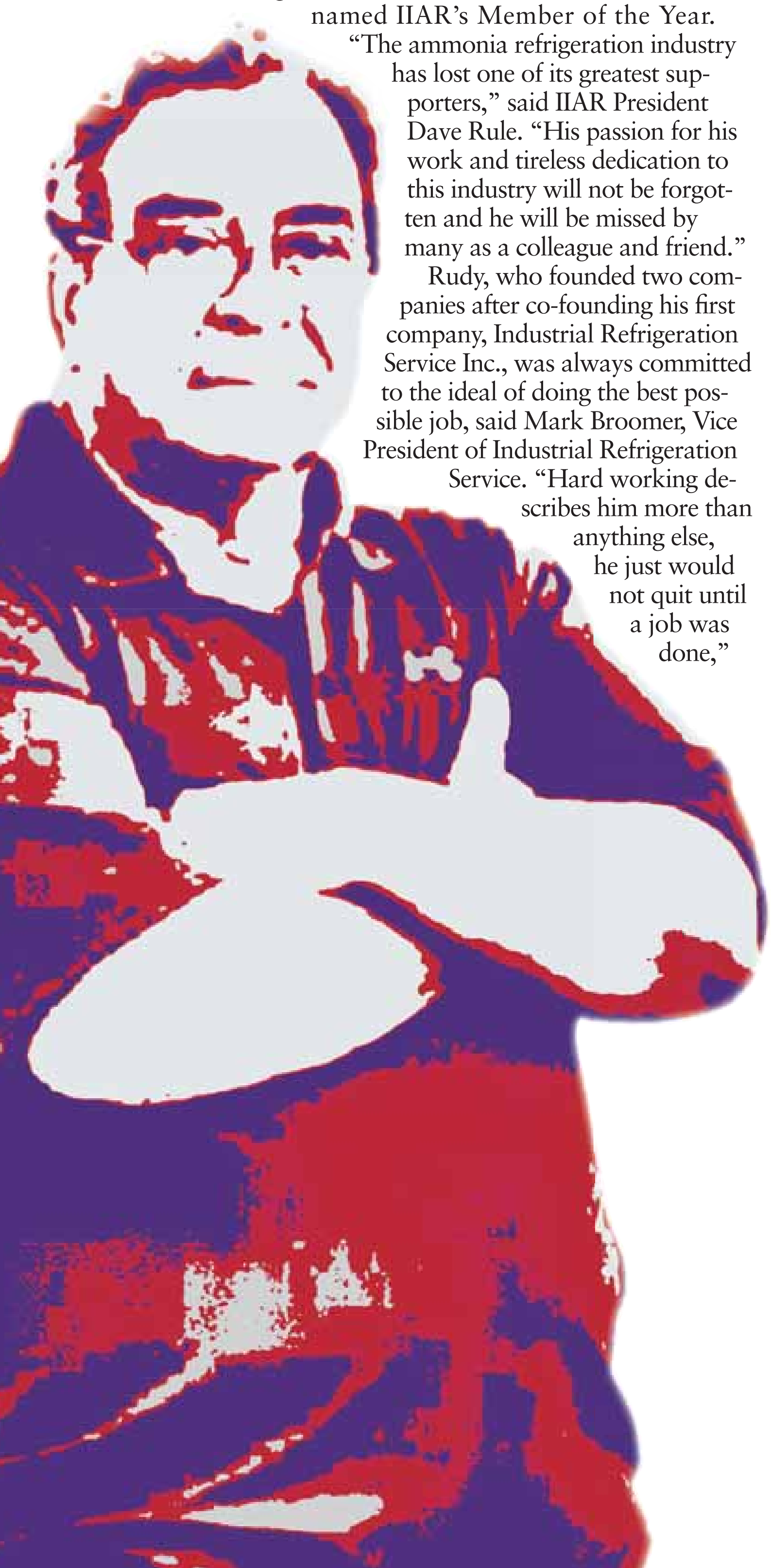
Third, if a facility plans to rely on local responders, and those responders are not trained for a hazmat response, the facility should decide ahead of time what safe and "defensive" actions it plans to take to reduce or stop a release in a shorter period of time.

Finally, facilities should be prepared to provide experts knowledgeable in the operation of an industrial ammonia refrigeration facility, and make plans for them to be quickly contacted if the facility refrigeration personnel are not readily available. ■

Remembering Rudy Nechay

Ammonia refrigeration lost one of its most entrepreneurial and dedicated leaders last month with the passing of Rudy Nechay, a man friends and family described as passionate about his work and devoted to the advancement of his industry.

Rudy was a longtime member of IIAR, serving on the board of directors and acting as treasurer for the Ammonia Refrigeration Foundation. In 2010, he was named IIAR's Member of the Year.



"The ammonia refrigeration industry has lost one of its greatest supporters," said IIAR President Dave Rule. "His passion for his work and tireless dedication to this industry will not be forgotten and he will be missed by many as a colleague and friend."

Rudy, who founded two companies after co-founding his first company, Industrial Refrigeration Service Inc., was always committed to the ideal of doing the best possible job, said Mark Broomer, Vice President of Industrial Refrigeration Service. "Hard working describes him more than anything else, he just would not quit until a job was done," he said. "Rudy brought his personality to his business. He built a well-respected company on the need to do the job right."

A former marine, Rudy seemed to never lose that commitment to excellence, said close friend and colleague Dennis Carroll. "He never forgot that he was a marine, and whatever that was that was instilled in Rudy, it never left him."

"Rudy always emphasized quality," said Broomer. "He always said he didn't want to be the biggest refrigeration company, he wanted to be the best."

And as a young entrepreneur building a business, he was not afraid to make decisions based on that ethic, said Broomer, who remembers Rudy tearing up invoices when a customer was not happy. "He wanted to make sure the job satisfied the customer, or he wasn't satisfied with it," said Broomer.

"He was larger than life," said daughter Natasha Arnold, adding that many friends, family members and even acquaintances remember Rudy as a man who was committed to the others around him. "He played a very significant role in many lives."

When it came to business, he was a man ruled by honesty and a deep appreciation for a job well done, said Carroll. But beyond that, "he was just a wonderful person to be around, I always wanted to hear what he had to say," he said, adding that Rudy was outspoken with a keen interest in the well-being of the industry.

As a father and mentor, he was instrumental in shaping the work ethic of all his children, said son Frank Nechay. "He was a wonderful father and mentor to all of us."

"As his children, we always knew he had a big impact on this industry," said son Nick Nechay. "But I didn't realize just how huge that was until he passed away. Everyone was at his service. Friends, competitors and customers, some of whom traveled long distances to be there, and they all had personal stories about him. That's a testament to who he was."

A member of several organizations, Rudy served on the IIAR and ARF board of directors, and was one of the original charter members of the Baltimore chapter of the Refrigerating Engineers and Technicians Association.

After serving a thirteen-month tour of duty as a marine in Vietnam, Rudy started his career in industrial refrigeration at Chesapeake Refrigeration Service. In 1978, he went on to establish Industrial Refrigeration Service, and followed that venture with three other companies: General Refrigeration Company in Delmar, Delaware, Polytemp Corporation in Baltimore, Maryland, and Independent Refrigeration Services in York, Pennsylvania.

The companies became a family business, and are now run by his two sons and daughter as well as his wife Eva.

"Our whole family works in this industry," said Nick Nechay, adding that the reason Rudy built a business that became a family venture was because "he poured his whole heart and soul into the industry and into his family."

In many ways, said Carroll, Rudy was also humble "like someone who couldn't believe his good fortune."

"He was always thankful for his business and his family."

And that optimism and openness is perhaps the biggest thing to miss about Rudy, said Carroll. "You never knew how a conversation with him was going to end, but you knew it was going to end well and you'd laugh somewhere in the process." ■

Eurammon Focuses on Sustainability at Annual Conference

The European organization representing natural refrigerants continued to emphasize the sustainable reach of refrigeration at its annual conference, which this year included a presentation from IIAR chairman, Bob Port.

The "Green Economy with Natural Refrigerants" symposium was held in June, in Schaffhausen, Switzerland.

During the symposium - organized by Eurammon, a joint initiative between European companies, institutions, and individuals committed to promoting the use of natural refrigerants such as ammonia, carbon dioxide, and hydrocarbons - presenters shared practical examples showing how natural refrigerants can be used sustainably.

"The purpose of the Eurammon conference was to show that going green is good business," said Port. "A lot of the papers case studied design of components and functionality of ammonia systems, including low-charge ammonia systems, using secondary refrigerants or secondary cooling fluids."

Examples included case studies, on a produce processing plant that was redesigned using a secondary cooling and minimum charge ammonia system, application of secondary coolants themselves in different design conditions, and heat exchanger applications.

About 65 individuals, representing consultants, contractors, and manufacturers, attended the symposium, and most of them were from Europe.

One reason Port said he was invited to give a presentation at the conference, was to share a North American end-user perspective.

During his presentation, "Sustainable Refrigerant Choices for North American Food Plants," Port discussed a case study which examined the replacement of commercial grade R-22 split system refrigeration equipment, at a food processing plant. The case study focused on how that equipment could be replaced with either a low-charge central system utilizing a secondary glycol freon (R134a) system, or a central ammonia system. "What I was trying to get across was that, when you talk about sustainability and lifecycle cost, putting commercial grade split systems on a food manufacturing plant that's going to be around for much longer than 10 or 15 years, you are not really doing something that's sustainable or even good for the business," said Port.

"By the end of the tenth year or so, that equipment is either pretty worn out or you're spending multiple times what it is worth just to keep it patched together." The most cost effective solution is a central ammonia system, Port said. "It was interesting because a lot of response I got from European attendees was that they had never seen ammonia come out as a low-cost system."

Just as valuable as the research and presentations shared at the conference, was the opportunity to share industry insight and knowledge with IIAR's global partners, said Port. "We're solidifying those alliances and getting the opportunity to get input, feedback, and exchange ideas."

One theme that emerged during these conversations with fellow attendees, he said, was that many of the European attendees are very concerned about increasing regulatory burdens. They were wondering, "How do we influence the government and the regulations so that we don't get regulated out of existence as a natural refrigerants industry? It was a huge concern," he said.

IIAR International Workshops Address Safety

BY CHRIS COMBS, IIAR INTERNATIONAL PROGRAMS DIRECTOR

On Monday, June 3 at about six o'clock in the morning, a fire broke out at a plant containing an ammonia refrigeration system which belonged to the Baoyuanfeng Poultry Company in the city of Dehui, in the Jilin Province of Northeastern China. Initial press reports included imprecise or contradicting explanations of the cause of the incident such as "negligence by company management and supervisory authorities" and noted that the company failed to implement workplace safety programs, eliminate hazards and conduct safety drills and training. Tragically, this incident led to the death of 119 individuals at the facility in addition to 60 individuals with injuries, some serious. The fact that safety exits were either locked or blocked – which is apparently a common practice to prevent workers from stealing or avoiding work and is frequently reported in the press – helps explain the high loss of life. The coverage also echoed calls for the government to pay more attention to the issue of worker safety.

The government later announced that "initial investigations into the cause of fire indicated that ammonia gas had triggered explosions." To this, it added factors including "flammable building materials, poor design of escape exits and insufficient fire prevention equipment." A source from the Chinese Association of Refrigeration provided a more nuanced explanation from the Chinese government: a short circuit in a processing workshop caused the initial fire, igniting nearby combustible materials; the resulting heat led to the bursting of ammonia piping and or equipment. The leaking ammonia is said to have led to more fire and explosions. One IIAR member in China commented that the final investigations of such incidents tend to be prolonged and are subject to manipulation due to political motivations.

According to former IIAR President Bruce Badger, this incident "was completely unnecessary for so many reasons. However, we should discuss all the ways that an electrical explosion should not have resulted in an ammonia explosion. The current machinery room designs in China, including gas detection and ventilation must be must be improved to meet IIAR Standards or similar accidents could occur." Such is the message that IIAR will continue to convey to its allies in China. IIAR will participate in a technical seminar in China later this year and, while there, will be discussing an initiative to provide and translate IIAR training materials for cold storage and food processing facilities designed by China's Internal Trade Engineering Design and Research Institute.

On April 10, an ammonia gas leak occurred at a soft drink facility in San Jose, Costa Rica, setting off an alarm at 11:20 am. Several hundred people were evacuated from the facility and the surrounding area, including a school and a kindergarten. The hazardous materials unit of the fire department was able to enter the area where the leak occurred and control the emergency. The fire department stated that the emergency occurred as a result of a valve rupture, which caused the ammonia leak.

At IIAR's next Industrial Refrigeration Seminar for Latin America, to be held in Costa Rica on October 15 and 16, a number of presentations will cover issues related to ammonia awareness and safety. The seminar will begin with a presentation describing ammonia properties, health effects of ammonia exposure, and risk analysis of ammonia as a refrigerant. This will be followed by a 100 minute workshop on ammonia handling which will cover personal protective equipment, ammonia transport, appropriate materials for use with ammonia, safety precautions, ammonia tank installation, and ammonia leaks. In light of the news of the ammonia safety incident just described, Ernesto Rodriguez of Hansen Technologies offered to present an overview of the fundamentals and applications of ammonia leak detection technology in order to stress the importance of ammonia safety to members of the ammonia refrigeration community in Central America. Finally, representatives of Danfoss, Parker and Hansen will participate together in a workshop on valve maintenance procedures which hopefully will help prevent future incidents in the region resulting from malfunctioning valves.

Besides the increased focus on ammonia safety in the IIAR Latin American seminars, IIAR has begun developing a Spanish language version of the Ammonia Safety series of education and training materials which includes modules covering personal protective equipment and emergency response.

The safety record of ammonia refrigeration applications in any region can impact the reputation, regulatory environment and well being of the ammonia refrigeration industry worldwide. That is why IIAR is now working to provide the knowledge that enables the safe and efficient use of ammonia as a refrigerant globally and must continue working to expand this effort to other regions around the world. ■

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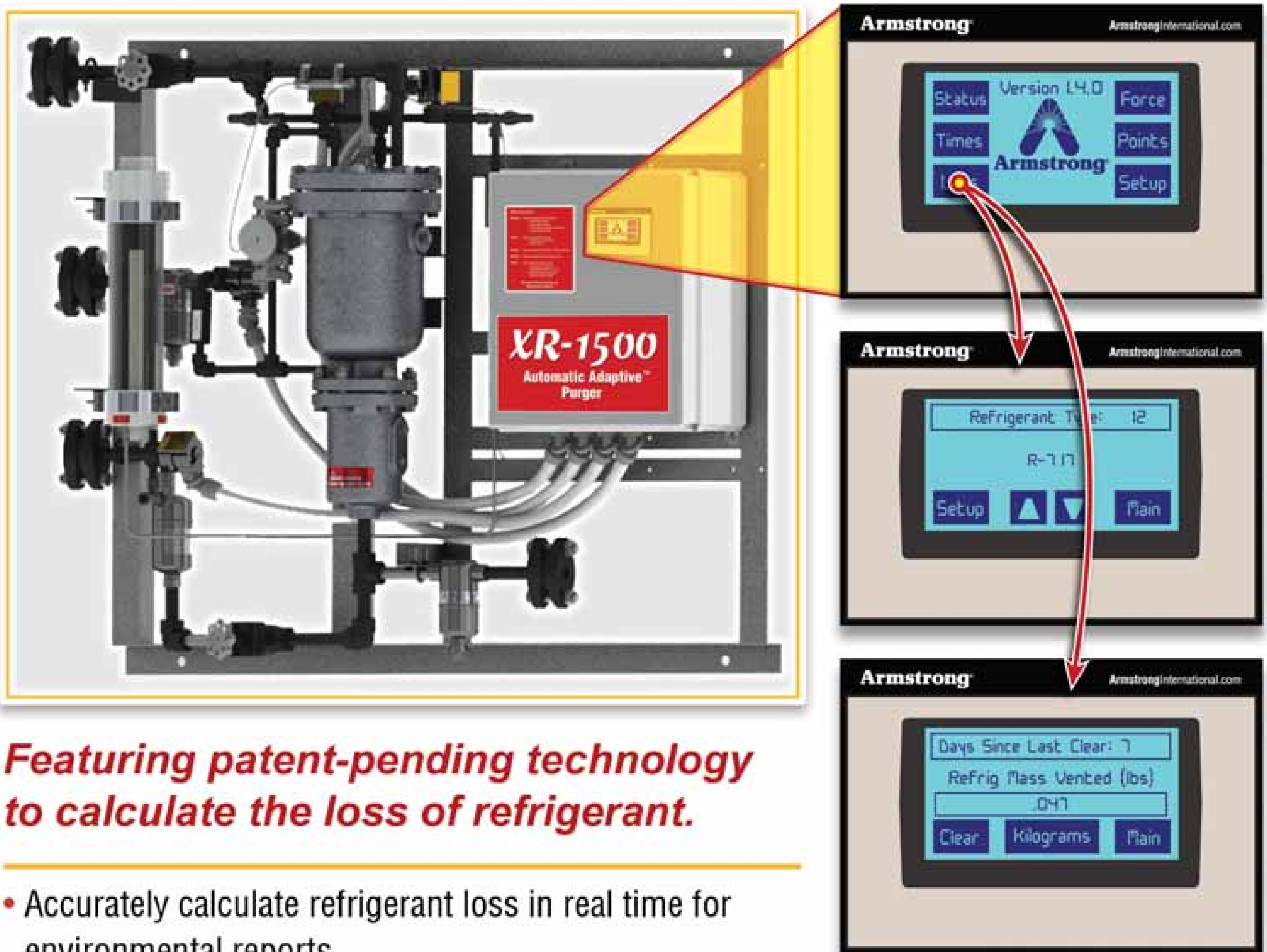

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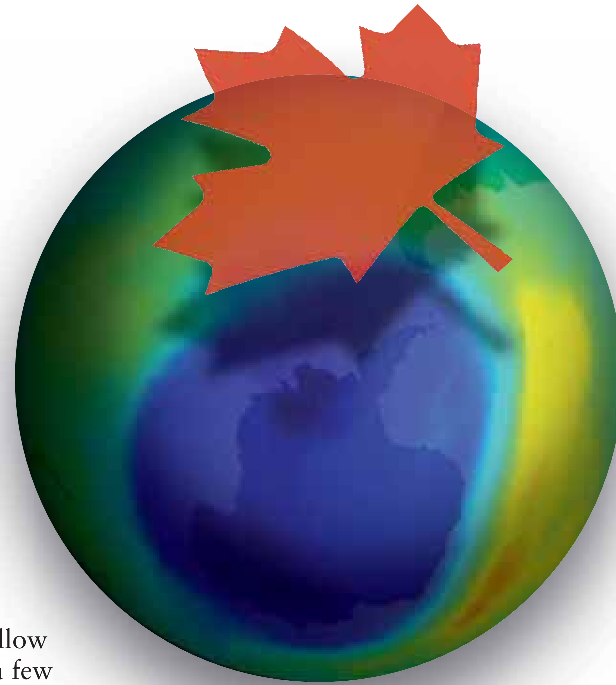

Earlier this year, the United States and China agreed to work together with other countries to use the expertise and institutions of the Montreal Protocol to phase down consumption and production of hydrofluorocarbons.

The agreement paves the way for more use of ammonia as an eco-friendly alternative. “When you take HFCs out of the equation, the real opportunities for alternative refrigerants are going to be the natural refrigerants,” said Lowell Randel, IIAR Government Relations Director. “It’s going to be ammonia.”

To fully understand the agreement between the United States and China and its implications for the ammonia refrigeration industry, it is first necessary to explain the Montreal Protocol, said Randel. The Protocol, which was established in 1987, is an international treaty designed to facilitate a global approach to combat stratospheric ozone layer depletion. That approach has been extremely successful, as the use of major ozone-depleting substances, such as chlorofluorocarbons and hydrochlorofluorocarbons has greatly decreased over the past few decades. In fact, the Protocol has led to the reduction of over 98 percent of all global production and consumption of controlled ozone-depleting substances, according to the Multilateral Fund for the Implementation of the Montreal Protocol.

But reducing the use of HCFCs and CFCs has raised some new problems. A big one: The use of potentially harmful alternatives, such as HFCs, is increasing. Though HFCs do not deplete the ozone, they are greenhouse gasses that could contribute to global warming.

That’s where the agreement between the United States and China comes in. As noted, the agreement states that the two countries will work together with other countries to use the expertise and institutions of the Montreal Protocol to phase down hydrofluorocarbons.

“China’s agreement to get on board with the United States could spur more countries to follow suit,” said Randel, noting that a few countries, such as India and Brazil, have been holding back on agreeing to take steps to reduce HFCs. One reason is that they fear the negative effects phasing out HFCs could have on their economies, he said.

> “This isn’t going to happen overnight, but it is clear countries want to move toward climate-friendly, safe alternatives from HFCs that have high-global warming potential.”
>
> **Lowell Randel, IIAR Government Relations Director**

As more countries take steps to phase out HFCs, the ammonia refrigeration industry could experience positive effects, said Randel. “First and foremost, when you look at the phase out of the R-22 refrigerant and other gases that were HCFS, you’re seeing ammonia and other natural refrigerants being used as the replacement refrigerants,” he said. “The same thing will happen with the HFC phase down.”

Still, as climate-friendly alternatives, such as ammonia refrigerants, grow in popularity, the shift away from HFCs will be a gradual one. “Countries are making progress toward agreement on a global phase down of hydrofluorocarbons under the Montreal Protocol, and some countries are already taking domestic actions as well,” said John Thomson, Deputy Director of Environmental Quality and Transboundary Issues in the Bureau of Oceans and International Environmental and Scientific Affairs in the Department of State.

“This isn’t going to happen overnight, but it is clear countries want to move toward climate-friendly, safe alternatives from HFCs that have high-global warming potential.”

Randel predicts that less developed countries that rely heavily on HFCs will likely shift away from them more slowly, while more developed countries, some of which are already moving away from HFCs, will undergo a shorter transition.

“You’re already seeing, in particular, new facilities moving away from an HFC choice to a natural refrigerant choice,” said Randel. “You’re going to continue to see fewer and fewer of the new HFC facilities being built because these companies are going to say, ‘Do I want to take the risk of building an infrastructure that’s reliant on an HFC as the refrigerant? Or, do I want to take into account the Montreal Protocol and some of these policy changes?’ Ammonia is going to be there and the industry will step up and say, ‘Hey you want efficiency? You want economic viability? Use ammonia.’” ■

IIAR Expands International Outreach with Colombia Visit

As the International Institute of Ammonia Refrigeration continues to establish itself as the primary resource for ammonia refrigeration and other natural refrigerants, international partnerships are more important than ever before.

"The IIAR, over the past three years, has formed a lot of alliances with international organizations," said IIAR Chairman Bob Port. "We are really working globally to promote IIAR and to build alliances that promote the safe use of ammonia, CO2 and natural refrigerants."

To help build up those alliances and share knowledge across the industry, IIAR has attended and hosted a wide variety of industry events and conferences at the international level. "This is an important year for us to get out and attend other meetings and learn from each other," said Port, adding that in many cases, at least one IIAR staff member or board member is attending an industry conference.

At the end of July, IIAR President Dave Rule and IIAR Chair Elect Marcos Braz attended the Spanish Inter American Congress for Air Conditioning and Refrigeration, in Cartagena, Colombia. The conference included a broad focus on environmentally sustainable technology, said Chris Combs, IIAR's International Programs Director, adding that this is the first time IIAR has been invited to participate in an ACAIRE conference.

"I think it represents the beginning of our relationship with ACAIRE and with Colombia because ACAIRE is a Colombian organization" said Combs. "I'm hoping that it will help us serve members of the industry in Colombia better; hopefully gain more members and more interest in what we do." Combs added that individuals throughout Latin America, Spain, Portugal, and Europe attended the conference. "It will, I think, give us some good exposure in the entire Ibero-American region."

Both Rule and Braz gave presentations at the conference. Braz, who served as the primary speaker for the event, walked attendees through the design, build, and operations of a meat processing plant from an engineering standpoint. He also spoke about low-charge ammonia package refrigeration systems.

During the opening speech, Rule spoke about the benefits of ammonia and other natural refrigerants as environmentally safe refrigerants and as a resource that can be used to expand the worldwide cold chain.

In a speech entitled, "Moving Towards a Greener Planet with Natural Refrigerants," Rule spoke about global warming challenges and the need to accelerate the use of technologies that do not contribute to global warming. He said his speech focused on ammonia and other natural refrigerants as the most practical and efficient refrigerants available to meet the challenges within the global cold chain.

Later, he spoke about the work IIAR does in developing proper operating standards and guidelines, especially IIAR's Ammonia Refrigeration Management Program, or ARM, manual, to ensure the safe and efficient application of ammonia around the world. He also outlined the preparation and training that is recommended for the first 30 minutes of response time in the event of an ammonia release. That program is based on the Ammonia Safety Training Institute, or ASTI, recommendations.

Called, "Developing Safety Guidelines for Your Facility: Prevention and Response Planning," the speech was meant to highlight that safety is the most important goal of the industrial refrigeration industry. The point of the speech was to convey that "every facility that uses ammonia should have a safety program that addresses prevention as well as emergency response," said Rule.

"IIAR is becoming recognized more and more around the world as a leader in ammonia refrigeration, as far as being a standards-writing body, and also developing good information for safety and training for ammonia systems," said Rule. "The whole intent is really to try to get our information out there and make sure that we are a resource for other countries that are working to follow good operating standards and procedures."

> "IIAR is becoming recognized more and more around the world as a leader in ammonia refrigeration as far as being a standards-writing body and also developing good information for safety and training for ammonia systems."
>
> **Dave Rule, IIAR President**

ARF Welcomes New Trustees, Board Chair

The Ammonia Refrigeration Foundation said that it recently welcomed three new trustees and board members.

The three new members, Donal Ballou, Peter Spellar and Walter Teeter have all held leadership positions within IIAR.

ARF, which serves as the research arm for industrial refrigeration, funds research projects and awards scholarships to support the growth of the industry.

The foundation's trustees are individuals who have made contributions to ARF of $50 thousand dollars each, and serve on the ARF Board of Directors.

"The ARF trustees play a very important role in making the goals of the foundation into a reality," said ARF Executive Director Tim Facius. "They are dedicated to the work of this industry and passionate about its future. All three of these men are respected leaders, and we're very excited to welcome them to ARF's Board."

DONAL BALLOU

PETER SPELLAR

WALTER TEETER

Currently, ARF is focused on bolstering its funding efforts so that it can continue to support its two primary initiatives, research and education.

That's a goal the three newest members of the ARF Board will be engaged in meeting, as they bring their own experience and dedication to the organization as leaders.

Donal Ballou said he made his contribution to ARF because the challenge of solving interesting problems was what kept him in the industry for an entire career.

"ARF is very close to the work of industrial refrigeration, because it allows us to solve problems, and as engineers, that's what we do best," he said. "This was my livelihood for my entire working career. It was always challenging, there were very few projects that were identical to other projects, and that presented all kinds of opportunities when it came to design. I loved it."

Ballou, who owned Refrigeration Systems Company, said his ARF contribution was a way to continue supporting an industry that provided him with such a rewarding career.

"I've always felt that people are in touch with each other in this industry," he said. "Nobody is cautious about discussing how to do something better. That's good for the industry and it's the way we educate each other."

Peter Spellar, president of SGS Refrigeration, Inc., said he made his decision to become an ARF trustee because he felt it was important to invest in the future of ammonia refrigeration, and ARF was a great way to make that investment.

"I felt like this was a great place to put my money," he said. "ARF is the place we can go to make funds available so that when there are valid projects that will have a real impact; we have the resources to do them."

Spellar, who recently assumed the role of chairman of ARF's Board of Trustees, said the idea of giving back was most important to him.

"There are some active programs that ARF is working on now, and we want everyone in this industry to know that they are able to make an impact by supporting them," he said. "We will encourage more contributions to ARF below the trustee level and raise awareness that ARF is a collective effort that anyone can join."

The fact that ARF represents a collective effort is the main reason to make a contribution to the foundation, said Walter Teeter, President of Republic Refrigeration, who added that he became a trustee for the same reasons cited by Ballou and Spellar.

"This industry has been a very important part of my professional life," he said. "Everything that has been addressed by ARF was at some point in time a challenge for all of us. I contributed to ARF because I want to see the foundation continue to tackle the issues that arise in our industry."

"There's always going to be a need for ARF, I don't foresee a shortage of things we'll need to look at in the future," he said. ■

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NATURAL REFRIGERANTS MEET GLOBAL WARMING CHALLENG

Driven by the forces of consumer optimism and business demand, the market for new environmentally friendly technologies has boomed in recent years. But now, environmental scientists are painting a bleaker picture: those new technologies will not be enough to slow global warming in the near future, when taking action to reduce greenhouse gasses will matter the most.

The world must identify existing sustainable technologies that are ready for immediate and wide-scale adoption.

As the search for those technologies intensifies, ammonia and other natural refrigerants are emerging as the most viable solutions for industrial refrigeration, thanks to international treaties that put pressure on countries to phase down CFCs and identify alternatives. At the same time, advances in system design are expanding the applications for ammonia systems around the world.

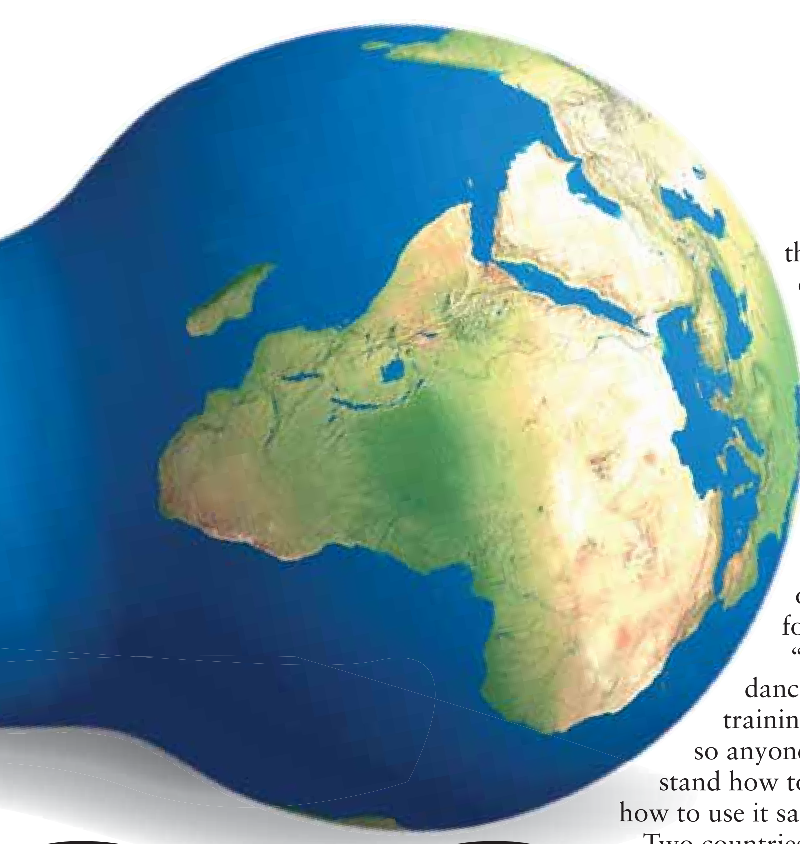
"Our ability to overcome our global warming challenges will depend on our ability to accelerate the use of technologies that do not contribute to global warming," said IIAR president Dave Rule. "Ammonia and other natural refrigerants are the most practical and efficient refrigerants available to meet those challenges right now within the global cold chain."

In the United States, the recent decision to join the Montreal Protocol – an international agreement to phase down the consumption and production of HFCs and other halocarbon refrigerants – and a renewed commitment from the White House to accelerate existing green technologies, represents "a significant step forward," said John Thomson, Deputy Director of Environmental Quality for the Department of State. Ammonia is currently on the Environmental Protection Agency's list of four hundred prioritized green technologies, he said.

At the same time, rapidly evolving small-package, low-charge ammonia systems may be changing the way the world looks at ammonia refrigeration, especially in emerging markets. Large-scale refrigeration facilities, traditionally run by ammonia systems, have long been the hallmark of industrial refrigeration in countries like the U.S. with the space and infrastructure to support them.

"The mega-structures that exist in places like the U.S. are not common in much of the world," said Richard Tracy, Vice President of International Programs for the Global Cold Chain Alliance, adding that because small-size facilities are easily charged by freon, those systems are more common in places where the cold chain is still developing. "The prevailing idea is that ammonia isn't considered unless a system is much bigger in scale. The ability to compete with smaller-scale systems would open up the door to the rest of the world for ammonia in places it has not been applied before."

Nevertheless, regardless of facility size, ammonia and other natural refrigerants have always been particularly



GES

well-suited to meet environmental needs while preserving efficiency, said Rule.

"In the United States, and many other parts of the world, natural refrigerants are beginning to get more attention as the best potential solution to many of today's problems, but the advantages posed by thermal performance, low cost, low environmental impact and simple technology have always made it one of the most efficient and practical solutions," he said.

Now that the focus is shifting to ammonia and other natural refrigerants, governments and standards-writing bodies around the world are looking for information on how to design, operate and maintain safe systems.

That's a need that IIAR is particularly well positioned to meet, said Rule, adding that the organization is taking on a greater role as a recognized international source for information about almost every facet of ammonia refrigeration, from design to safe operation.

"Because of the efforts of IIAR and other organizations around the world, there are detailed codes and standards that have been developed which provide industry vetted guidelines," he said. "These standards address equipment and system design, installation, maintenance and process safety guidelines to ensure that management and operators are prepared for any emergency."

"There is an abundance of information and training materials available, so anyone anywhere can understand how to use ammonia, and how to use it safely."

Two countries that have recently turned to IIAR for information are Brazil and Colombia.

In Brazil, the national standards organization, ABNT, is working in conjunction with the Brazilian Association of Refrigeration, Air Conditioning, Ventilation, or ABRAVA, to write a national standard for ammonia.

"ABRAVA has asked IIAR to supply an IIAR standard, IIAR-2, as a reference for their own ammonia standard," said IIAR Chairman-elected, Marcos Braz. "That standard, once it is formed, will then be proposed to the Brazilian government, which will use it as a reference for future regulations referencing ammonia."

Nevertheless, the use of IIAR standards as models for other countries and international organizations looking to create their own standards is just one example of the growing focus on the industry and the organization that represents it, said Braz.

Recently, the Colombian government requested – through ACAIRE the Colombian Association of Air Conditioning and Refrigeration – that IIAR give a presentation on the sustainability of ammonia refrigeration at the XII CIAR Convention, Spanish Ibero American Congress for Air Conditioning and Refrigeration, sponsored by FAIAR members including ASHRAE.

The purpose of the request, said Braz, was to outline the basic process of the design and construction of a facility that would deliver efficiency and maximize environmental gains.

The invitation was significant, he added, because it was the first time the well-established international convention on its twenty-second year focused specifically on natural refrigerants.

"This was one of the most important conventions in that area to allow that much space for ammonia," said Braz. "There's interest now where there wasn't a focus before."

"The Department of the Environment and Sustainable Development in Colombia was asking IIAR to be there. It's significant that this was an invitation from the government through ACAIRE. It's an example of how other countries are starting to take note of this industry and look to IIAR as a valuable reference."

As for the technical presentation he gave to the organization, Braz said his primary goal was to provide a simple guideline for the best way to design a process plant to achieve environmental sustainability.

"The purpose was really to help them understand the applications of ammonia as a sustainable refrigerant for industrial use," he said.

However, the presentation was also a way to outline the implementation of some of the best standardized processes for a meat process plant and how they might be expanded for application on a global level.

As international focus on natural refrigerants continues to grow, there will be many more opportunities for the industrial refrigeration industry to make its standards available and lend its experience to those organizations and countries that will be looking for guidance, said Braz. "Industrial refrigeration is positioned to grow around the world, and it will be able to expand, thanks to the large body of information we've cultivated in the form of standards, reference materials, training and our own real world experience. IIAR, and the industry at large, is ready and well prepared to share that knowledge."

The technical paper re-printed below was produced at the request of the Colombian Association of Air Conditioning and Refrigeration and the Colombian Department of the Environment and Sustainable Development to illustrate the design and construction of a meat processing plant. In this paper, author Marcos Braz, outlines the factors that should be considered in creating a design that meets the goals of environmental sustainability while maintaining efficiency and safety.

SUSTAINABLE REFRIGERATION OF PROCESS PLANTS UNDER SANITARY STANDARDS

BY MARCOS R. BRAZ, PE

NOTE: *This paper was presented at the XII CIAR 2013 convention in Cartagena Colombia on July 23rd, 2013. The participation of Marcos Braz, PE, Chair Elect of IIAR, was sponsored by the Unidad Tecnica Ozono - UTO, from the Colombian Department of Environment and Sustainable Development. The UTO is the office in charge of implementing the Montreal Protocol in Colombia.*

SUSTAINABLE EXPECTATIONS

An era of global interaction, fueled by advances in communication and transportation, has revolutionized the way food is produced, transported and distributed, and the food industry must meet the challenge of providing nutritious and fresh, but perishable, products at an affordable cost while minimizing or neutralizing any direct impact on the environment. While the problems presented by airborne bacteria, including E.coli, Listeria and Salmonella have been minimized by a globally advanced cold chain, they still deserve a great deal of attention from a design perspective.

At the early stages of a meat process plant design, the real estate-required production rates, equipment and the number of people necessary to produce the work are the main factors in obtaining real financial results. Moreover, the economic plan for the growth of such a plant needs to meet the global demand for quality and competitive costs. This paper will outline the ways in which those challenges may be met.

SPOILAGE AND ENVIRONMENTAL IMPACT

The growth of harmful microorganisms in food production and its environment have a direct impact on our daily lives. These days, thanks to global advances in technology and logistics, we are eating fruits, drinking juices and obtaining diverse protein products from distant countries, thanks to the ease of transporting refrigerated food across the globe.

Nevertheless, we are vulnerable to the related hazards that account for thousands of deaths per year (estimated at 9,000 per year in the USA) while food spoilage is estimated at 20 to 40 percent on average worldwide.

These problems deserve attention if we are going to achieve the final product quality required by international standards.

How do these important aspects of global interaction relate to the design of a process plant? Or, in the case of this paper, a slaughter and meat packaging plant?

To answer that question, design must be considered first. All the facets of design should be made to work together to achieve results from an economic, environmental and health perspective.

REFRIGERANT SELECTION

The refrigeration system of a slaughter and meat processing plant is responsible for integrating the sanitary requirements for production, including process environment temperatures. Additionally the refrigeration system accounts for 60 to 80 percent of the electrical energy consumption and consequent environmental impact in relation to its carbon foot print.

Ammonia has been chosen by the vast majority of industrial plants in the world as reliable and efficient – due to its spectacular thermal properties (see Appendix A) – refrigerant, noted for its resilience by keeping somewhat workable efficiency under the undesirable presence of impurities such as water and air. This is a very important factor that allows the industry to operate in less than ideal conditions until corrective actions are taken.

Ammonia is produced by the human body from the metabolism of protein, amino acids and other nitrogen-containing chemicals. The human body produces ammonia at a rate of 50 mg per day. Although essential, ammonia can be a toxic agent to the extent to which its concentration in the air rises.

Ammonia can cause burns on exposed human tissue, including the respiratory tract, eyes and skin when its concentration reaches lethal levels (5,000 to 10,000 ppm, or parts per million) in short periods of exposure. The level of concentration known as Immediately Dangerous to Life and Health, or IDLH, is 500 ppm. This level is determined as the level at which a worker can be exposed for 30 minutes without suffering irreversible health effects.

The irritating and pungent odor of ammonia makes this refrigerant easily detected at much less than 25 ppm. Therefore, it is self-alarming. The concentrations from 25 to 35 ppm do not represent an immediate health risk, even for prolonged periods of exposure.

It is very important to note that only at concentrations of 15 percent to 25 percent is ammonia flammable by deflagration and not by violent explosion. This means that its flame velocity, at these concentrations, is much lower than other flammable substances. There are no reported cases of ammonia ignition at any concentration in an open environment.

Therefore, it is necessary to respect this natural inorganic substance with safety procedures that include operator training, proper equipment and maintenance.

Leaks of ammonia in the environment require as much attention to the protection of people as to nature. Having been used as a refrigerant for more than 100 years, ammonia's characteristics are well known and this means the design engineer has all the information needed to design a safe and stable system, and to be prepared for any emergencies.

SUSTAINABLE AMMONIA PRODUCTION:

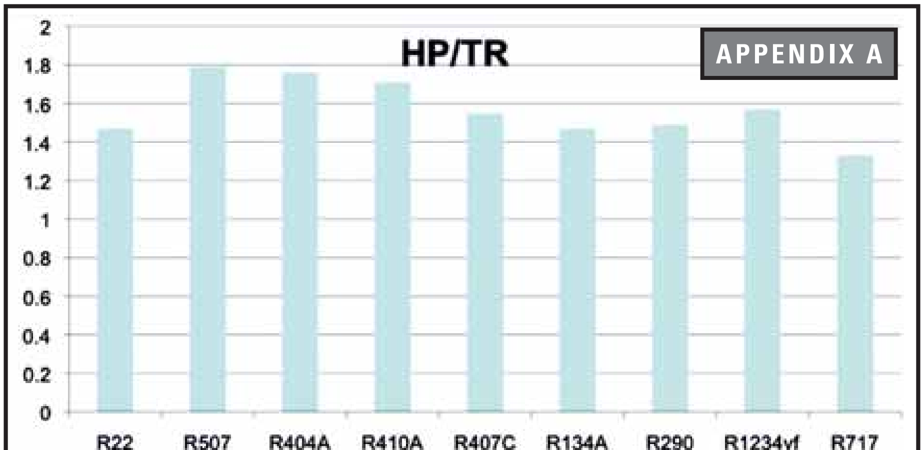
Steam reforming, sometimes called fossil fuel reforming, is a method for the production of hydrogen, or other useful products from hydrocarbon fuels such as natural gas. This is achieved in a processing device called a reformer which reacts steam at high temperature with the fossil fuel. The steam methane reformer is widely used in the industry to make hydrogen.

To produce the desired end-product ammonia, the hydrogen is then catalytically reacted with nitrogen (derived from process air) to form anhydrous liquid ammonia. This step is known as the ammonia synthesis loop (also referred to as the Haber-Bosch process):

$$3H_2 + N_2 = 2NH_3$$

Ammonia production depends on plentiful supplies of natural gas, a finite but abundant resource, to provide hydrogen. Due to its critical role in intensive agriculture and other processes, sustainable production is desirable. This is can be achieved by using renewable energy to generate hydrogen by electrolysis of water. Electrolysis of water is the decomposition of water (H_2O) into oxygen (O_2) and hydrogen gas (H_2) due to an electric current being passed through the water. In practice, natural gas will remain the major source of hydrogen for ammonia production as long as it is cheapest.

Waste water is also often high in ammonia. Because discharging ammonia laden water into the environment can cause problems, nitrification is often



Conditions were established for a given Open Drive Screw Compressor. Ratings above were obtained at Saturation Suction Temperature of 1.7°C and Discharge Temperature of 46°C.

necessary to remove the ammonia. This may be a potentially sustainable source of ammonia in the future because of its abundance and the need to remove it from the water anyway.

AMMONIA REFRIGERATION:

In general, the Slaughter Process Plant is composed of a slaughter area, hanging, bleeding and offal evisceration, followed by rapid cooling, staging, deboning, special cuts, vacuum and packaging areas.

Typically one could estimate for a slaughter plant with frozen and refrigerated packaging: a 17 to 20 TR/ Head Hour of refrigeration capacity at 1.2 hp/ TR which, at 100 heads per hour, can result in a refrigeration system consuming upwards of 2,400 HP of power. This translates into a 0.016 KW/ pound to 0.021 KW/ pound range of energy usage.

It is imperative, then, to utilize a refrigerant that results in the most sustainable refrigeration system with the lowest carbon footprint considering the magnitude of power consumption.

For a Two Stage Refrigeration System with SST -30 F (-34.4°C) / SST 20 F (-6.7 °C) TO DST 96 F (35.5°C)

- **R717 (ammonia) COP 4.11/4.48**
- **R22 COP 3.80 /4.15**
- **R404a COP 3.36/4.52**
- **R134a COP 3.33/2.52**
- **Ammonia/CO2 COP 3.8 / 5.83 * cascade system at 15 F**
- **Hydrocarbon 3.79/4.27**

The numbers above are achieved with ammonia on low and high temperature stages. It is important to note that new technologies are being developed with CO_2 as the refrigerant of choice for low suction temperatures (below -40 F), mainly due to the reduced pressure drop and estimated energy efficiency. There are factors yet to be overcome that require careful analysis or special design for CO_2 refrigeration systems given limitations with higher pressures, defrost, screw type compressors performance, triple point at 75 psig ("dry ice') , oil type and other system management issues.

INTERTWINING INDUSTRIAL REFRIGERATION EFFICIENCY WITH PRODUCT PROCESS QUALITY

Facility Programming:

At the very early stage of the project, several factors could significantly reduce the final energy bill of a given facility. For example, factors resulting from the site selection include:

- **Prevailing Winds**
- **Traffic in Paved Areas**
- **Rendering Plants or Wastewater Treatment**
- **Machinery Room Location**
- **Process Flow**

Hazard Analysis and Critical Control Points:

HACCP is a management system in which food safety is addressed through the analysis and control of biological, chemical, and physical hazards from raw material production, procurement and handling, to manufacturing, distribution and consumption of the finished product.

The HACCP was developed to ensure that Process Plants address the continued monitoring of food processed with regard to its quality, and therefore, lack of contamination. It can be summarized in two main principles:

Principle 1: Conduct a hazard analysis. Plans determine the food safety hazards and identify the preventive measures the plan can apply to control these hazards. A food safety hazard is any biological, chemical, or physical property that may cause food to become unsafe for human consumption.

Principle 2: Identify critical control points.
A critical control point (CCP) is a point, step, or procedure in a food manufacturing process at which control can be applied and, as a result, a food safety hazard can be prevented, eliminated, or reduced to an acceptable level.

One of the main objectives of a process plant is to reach product quality while decreasing the energy consumption, or costs, to produce it.

In this paper, we address the impact of sanitary design of a slaughter meat plant and its consequences for the refrigeration system energy consumption, meaning that you can be saving energy while complying with the highest sanitary standard required.

For example, the control of odor, dust and particulates should start as a higher priority since the plant location with prevailing winds and surrounding industries could have a negative or positive impact on the plant's final electrical bill and product quality. The upwind location of a rendering plant near the process areas could be easily avoided during the planning phase. See appendix A.

Mitigating these effects afterwards impacts the installed refrigeration system directly, that now has to cope with reduced air intake and increased consumption of energy during cleaning and drying mode since it cannot bring fresh air in.

Infiltration of outside air is one of the most important factors in energy consumption. It is easily estimated that 1,000 CFM of outside air on a warm day (96°F [36°C]/ 45% RH) brings 10 TR of extra load to a 35°F [2°C]/ 70 % RH environment. A 50°F [10°C]/ 70 % RH environment will be penalized at 8 TR.

The air coming from outside should always be filtered and should be limited to what would be required to keep the process area environment under correct pressurization and, or, to provide enough fresh air to production areas. However, it must be kept to a minimum to avoid the thermal penalty described above.

In a slaughter process area, it is very common to produce negative pressure with the exhaust fans where the goal is to achieve humidity control and create a counter flow of contaminated air against the product process.

Although desirable from the perspective of sanitary control, an unmeasured amount of air extraction will provoke a huge amount of refrigeration load since it will carry most of the air conditioned air from adjacent areas. The solution to this problem is achieved by balancing supply and exhaust fans to produce just the desired amount of negative pressure while moving the moisture and contaminants away.

From AMI (American Meat Institute)

the principles of Sanitary Design include:

Establish Distinct Hygienic Zones in the Facility
Maintain strict physical separations that reduce the likelihood of transfer of hazards from one area of the plant, or from one process, to another area of the plant, or process, respectively. Facilitate necessary storage and management of equipment, waste, and temporary clothing to reduce the likelihood of transfer of hazards.

Temperature and Humidity Control in Process Areas
Controlling Relative Humidity should be prioritized instead of just lowering the temperature of the room. The correct control of relative humidity translates in avoiding condensation dripping over the product as well as avoiding condensation over the product that was cooled, chilled or frozen.

From 24 to 26 hours after sacrifice at the Slaughter plant, the meat carcass goes from 105 degrees to close to 38 degrees F [41°C to 3°C] where it will be processed in the deboning room. The control of relative humidity in the de-boning area should create a dew point higher than the product (meat) surface temperature.

This is accomplished by keeping the 50°F [10°C] room at 60% RH. This will produce a dew point of 37 degrees F [2.8°C] which will prevent the meat from condensing moisture over its surface.

Condensation control not only achieves the sanitary goals of a meat process plant, but also creates savings from having to lower the room temperatures to avoid microbial growth. It is more economical and safe to control the relative humidity of the air than to reduce the temperature of the room with additional thermal load removal.

Usually, lowering the room temperature will penalize the energy consumption and accomplish more moisture migration to the room due its greater differential temperature and potential to provoke condensation. Besides that, the comfort of the workers will be impaired when you impose close to freezing temperatures in the room for manual labor.

From AMI sanitary design principles for the design, construction, and renovation of food processing facilities to reduce food safety hazards.

Room Temperature and Humidity Control
Control room temperature and humidity to facilitate control of microbial growth. Keeping process areas cold and dry will reduce the likelihood of growth of potential food borne pathogens. Ensure that the HVAC/refrigeration systems serving process areas will maintain specified room temperatures and control room air dew point to prevent condensation. Ensure that control systems include a cleanup purge cycle (heated air make-up and exhaust) to manage fog during sanitation and to dry out the room after sanitation.

There are different types of equipment and approaches to provide the correct temperature and humidity control to a given area at the plant. There are three main types of Air Handling Units available, each with its own moisture and temperature control capabilities such as:

- **Mechanical Cooling with Reheat Coil**
- **Dry Desiccant Wheel**
- **Liquid Desiccant**

It is important to note the safety aspects of these units assisting the processing areas.

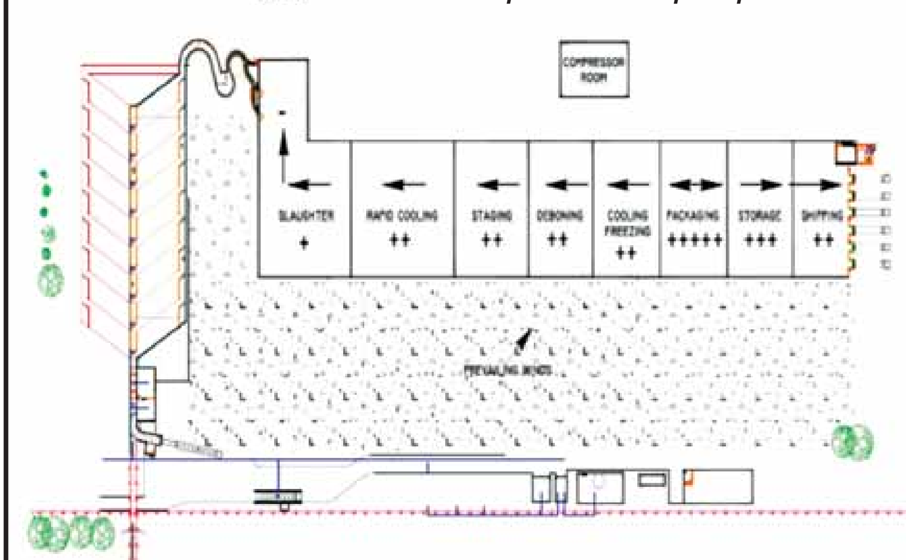
The following are recommended "must haves" for all processing areas in the plant as a minimum:

- **Ammonia alarm at air handling units discharge (before the final filter downstream of the cooling coil)**
- **Integral flow exhaust fan to be used to exhaust the room to atmosphere, usually at 12 to 15 air renovations per hour**
- **Stainless steel coils with aluminum fins**
- **Interlocked controls with valve groups, machinery room and other roof ventilation equipment**

Pressurization of Packaging and Deboning Processing Areas
Almost as obvious as the correct separation of the hygienic areas with a focus on traffic and a decreased amount of openings (read as doors), is the correct pressurization that will allow minimum cross contamination potential as well as a reduction in energy consumption, as explained before.

APPENDIX B

The arrows indicate the desired Air Flow orientation with the "++.." signs indicating the level of pressurization inside the plant rooms/areas compared to the atmospheric pressure.



It is important to note the implication of fresh air brought into pressurization areas and how it relates to the energy consumption of the plant. Pressurization costs are closely related to the amount and quality of the openings to adjacent areas. Remember that we showed that 1,000 CFM will easily produce an extra 10 TR requirement on the refrigeration system. See Appendix C.

From AMI sanitary design principles for the design, construction, and renovation of food processing facilities to reduce food safety hazards.

Room Air Flow and Room Air Quality Control

Design, install and maintain HVAC/refrigeration systems serving process areas to ensure air flow will be from cleaner to less clean areas, adequately filter air to control contaminants, provide outdoor makeup air to maintain specified airflow, minimize condensation on exposed surfaces, and capture high concentrations of heat, moisture and particulates at their source.

APPENDIX D

Thermal Loads for Door Opening — NO PRESSURIZATION
Outside Air Temperature
95 DB / 55% RH 81 WB

Door Size — TR based on Temperature Differential and Door Opening Frequency

W (ft)	H (ft)	34F/50%	34F/60%	34F/70%	34F/80%	34F/90%
5.0	7.0	19.4	19.1	18.9	18.6	18.3
5.0	8.0	23.7	23.4	23.1	22.7	22.3
6.0	8.0	28.5	28.0	27.7	27.2	26.8
6.0	9.0	34.0	33.5	33.0	32.5	32.0
6.0	10.0	39.8	39.2	38.7	38.1	37.5
7.0	8.0	33.2	32.7	32.3	31.8	31.3
7.0	9.0	39.6	39.0	38.5	37.9	37.3
7.0	10.0	46.4	45.7	45.1	44.4	43.7
8.0	8.0	38.0	37.4	36.9	36.3	35.7
8.0	9.0	45.3	44.6	44.0	43.3	42.7
8.0	10.0	53.1	52.3	51.6	50.8	50.0
10.0	10.0	66.3	65.3	64.5	63.4	62.4
10.0	12.0	87.2	85.9	84.7	83.4	82.1
10.0	14.0	109.9	108.2	106.8	105.1	103.4
12.0	12.0	104.6	103.0	101.7	100.1	98.5
12.0	14.0	131.9	129.8	128.2	126.1	124.1
12.0	16.0	161.1	158.6	156.6	154.1	151.7

Number of Openings/hr	30.0	INPUT
time for door to open (sec)	5.0	INPUT
time for door to close (sec)	5.0	INPUT
time fully open (sec)	40.0	INPUT
percentage opening	37.5%	

Thermal Loads for Door Opening — NO PRESSURIZATION
Outside Air Temperature
95 DB / 55% RH 81 WB

Door Size — TR based on Temperature Differential and Door Opening Frequency

W (ft)	H (ft)	34F/50%	34F/60%	34F/70%	34F/80%	34F/90%
5.0	7.0	19.4	19.1	18.9	18.6	18.3
5.0	8.0	23.7	23.4	23.1	22.7	22.3
6.0	8.0	28.5	28.0	27.7	27.2	26.8
6.0	9.0	34.0	33.5	33.0	32.5	32.0
6.0	10.0	39.8	39.2	38.7	38.1	37.5
7.0	8.0	33.2	32.7	32.3	31.8	31.3
7.0	9.0	39.6	39.0	38.5	37.9	37.3
7.0	10.0	46.4	45.7	45.1	44.4	43.7
8.0	8.0	38.0	37.4	36.9	36.3	35.7
8.0	9.0	45.3	44.6	44.0	43.3	42.7
8.0	10.0	53.1	52.3	51.6	50.8	50.0
10.0	10.0	66.3	65.3	64.5	63.4	62.4
10.0	12.0	87.2	85.9	84.7	83.4	82.1
10.0	14.0	109.9	108.2	106.8	105.1	103.4
12.0	12.0	104.6	103.0	101.7	100.1	98.5
12.0	14.0	131.9	129.8	128.2	126.1	124.1
12.0	16.0	161.1	158.6	156.6	154.1	151.7

Number of Openings/hr	30.0	INPUT
time for door to open (sec)	5.0	INPUT
time for door to close (sec)	5.0	INPUT
time fully open (sec)	40.0	INPUT
percentage opening	37.5%	

Meeting international sanitary regulations creates energy savings and a competitive advantage for a well designed slaughter beef process plant.

Walls, Roof and Floor Insulation

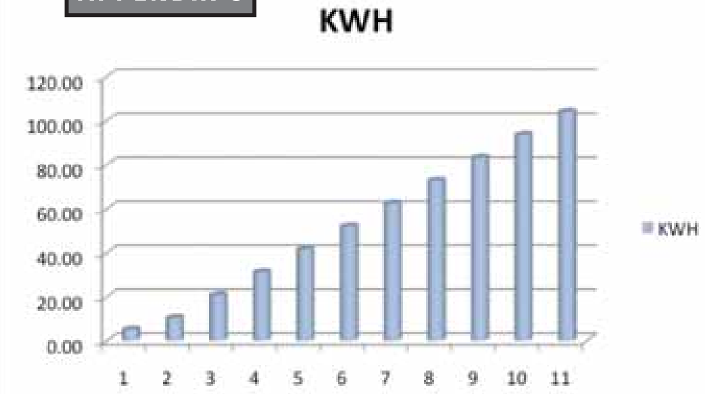
The separation of areas is accomplished physically through insulated walls that also act as barriers to contamination from adjacent areas. It is very important to assure proper vapor barrier at the warm side to avoid the migration of moisture by a difference in vapor pressures that will bring moisture to the insulation with detriment of the insulation values. This will result in increased heat conduction with energy losses and condensation occurring at the warm side due to the loss of insulation R value.

The floor insulation must be considered since an un-insulated floor will conduct 15 to 20 times more than an insulated floor with R=32.

Doors

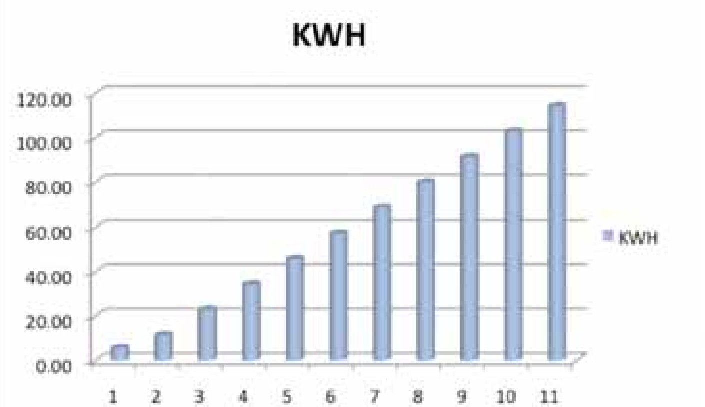
The selection of doors for the differential of temperature and traffic frequency is of extreme importance to maintain the correct pressurization in the process areas as well as to avoid air infiltration between these areas. There are numerous types and models of doors that will work for the traffic and temperatures between the adjacent areas. The choice should be always for fast acting doors and

APPENDIX C



AIR INFILTRATION / RENOVATION
96 F / 54 RH to 34 F/ 80 RH
PRESSURIZATION OF 0.01 inches of water

OPENING FT2	CFM	MPH	KWH
0.5	120	2.73	5.20
1	240	2.73	10.40
2	481	2.73	20.80
3	721	2.73	31.19
4	961	2.73	41.59
5	1202	2.73	51.99
6	1442	2.73	62.39
7	1682	2.73	72.78
8	1922	2.73	83.18
9	2163	2.73	93.58
10	2403	2.73	103.98



AIR INFILTRATION / RENOVATION
96 F / 54 RH to 34 F/ 80 RH
PRESSURIZATION OF 0.015 inches of water

OPENING FT2	CFM	Velocity MPH	KWH
0.5	147.15	3.34	5.72
1	294	3.34	11.43
2	589	3.34	22.86
3	883	3.34	34.29
4	1177	3.34	45.72
5	1472	3.34	57.15
6	1766	3.34	68.58
7	2060	3.34	80.02
8	2354	3.34	91.45
9	2649	3.34	102.88
10	2943	3.34	114.31

preferably easily reparable after impact.

Air curtain doors must be selected with care since they have to match the frequency of openings and differential temperature between the separated areas. Refer to Appendix D.

Interstitial Space Ventilation

The ambient temperature we find above the ceiling is of great importance to ventilate and create enough convection to avoid condensation over the insulated ceiling due to stagnated air. It is also important to decrease the temperature differential caused by ancillary equipment load (air compressors, vacuum pumps, etc.) using proper ventilation.

Wash Down / Cleaning and Pre-Operational Time

The Cleaning Cycle must be addressed correctly. Use outside air when the outside temperature allows for removing the excessive steam produced during the wash-down. It will remove most of the moisture with a 100 percent exhaust flow provided by the air handling unit or exhaust system. It is important that the cooling and dehumidification mode should be utilized after the air renovation is accomplished. The use of burners to heat the air is advised when temperatures outside are lower than room operating conditions. The objective is always to remove the excessive moisture of the cleaning cycle using an economized mode of outside air.

It should be noted that the cleaning cycle could happen when nearby areas are still in production mode. The relevance of doors insulating the wash down process from production is then highly augmented.

From AMI sanitary design principles for the design, construction, and renovation of food processing facilities to reduce food safety hazards.

Water Accumulation Controlled Inside Facility

Design and construct a building system (floors, walls, ceilings, and, supporting infrastructure) that prevents the development and accumulation of water. Ensure that all water positively drains from the process area and that these areas will dry during the allotted time frames.

IN CONCLUSION:

Meeting international sanitary regulations creates energy savings and a competitive advantage for a well-designed slaughter process plant.

Establishing a sanitary and energy efficient layout, while keeping the pressurization and infiltration controlled to optimum levels will minimize the energy consumption.

Complying with sanitary standards can be translated into optimized and efficient usage of energy from refrigeration systems with a consequent reduction of the carbon foot print. Ammonia, a natural, efficient and abundant refrigerant presents itself as a strong element in this industry to minimize environmental impact, while promoting sustainability for years to come.

Using Electronic Records Systems

from the technical DIRECTOR

BY ERIC SMITH, P.E., LEED AP, IIAR TECHNICAL DIRECTOR

Everyone is going paperless! Well, not entirely, of course. Not long ago, a member contacted the IIAR and noted that the mechanical integrity chapter of the IIAR PSM/RMP guidelines states that "Copies of the completed log sheets and maintenance and inspection records should be kept on file. Maintenance of these records will allow you to determine the operating history of the facility and to satisfy regulatory and corporate requirements. Maintenance and inspection records will provide direction for needed repairs and maintenance." The guidelines do address the use of computerized maintenance systems, but have not addressed electronic records keeping.

The member's company is going to a computerized maintenance scheduling and records keeping system. They would like to do away with paper records, but were wary that a lack of paper would not be acceptable by OSHA and, or, the EPA.

The IIAR reached out to some contacts at both EPA and OSHA to get a response on the topic, and their response is paraphrased below. The agencies raised some important considerations in moving away from paper that should be kept in mind in any such transition.

Many companies already use electronic records systems. The agencies see them all the time. The term "electronic" includes things like inspection or testing records that were originally done in hard copy, but were scanned and stored as a PDF file, as well as electronic logs, databases, equipment monitoring records, etc. Nothing in the regulations prohibits electronic recordkeeping, but those electronic records still need to meet the requirements of the rule. So if something is supposed to be certified (e.g., compliance audits, operating procedures), you still have to have a way to show that it was certified. The agencies interpret certification to mean signed and attested as accurate by someone in a position of responsibility, so that usually means there had to be a paper document at some point for someone to sign. It could then be scanned into an electronic file system later. And there are times when purely electronic records don't work as well – where field personnel need to have copies of operating or maintenance procedures on hand for example. Also, when eliminating paper records, companies need to be careful not to do away with records that substantiate compliance with the regulatory requirements. Some things are obvious, for example PHAs that must be retained for the life of the process. Some things are less obvious – for example if they have hardcopy NDE results for a process vessel. The agencies and IIAR advise against throwing those away without making sure that they are scanned into an electronic file system and backed up. There are things like piping and instrumentation documents that can be difficult to transition to an electronic format without specialized software and lots of effort. P&IDs and other process safety information need to be updated pretty often if changes occur, so simply scanning an old paper P&ID into PDF form doesn't do much for you.

In any case, electronic records must be made readily available and accessible for operators, records keepers and inspectors. Further, electronic records must have a "rock solid" backup system.

A different issue regarding standing water was raised by another member. This member asked if it was common to hear about citations issued for standing water in machinery rooms or production floors. To our knowledge, this has not been a problematic citation in our industry, at least in terms of PSM requirements. But generally, OSHA is concerned about walking and working surfaces. OSHA rule 1910.22(a)(2) states:

"The floor of every workroom shall be maintained in a clean and, so far as possible, a dry condition. Where wet processes are used, drainage shall be maintained, and false floors, platforms, mats, or other dry standing places should be provided where practicable."

This is a broad ruling that is ripe for inconsistent interpretation by using terms like "as far as possible" and "where practicable." It is common that condensation water from ammonia pumps, un-insulated valves and perhaps other refrigeration equipment is practically inevitable. The best approach is to be sure that housekeeping pads and equipment foundations are designed or modified to allow water to reach floor drains as best as possible, and to address places where water tends to stand by installing drains or raising the surface and redirecting the water. Another possibility is to vacuum puddles if they occur infrequently. Although this seems like a minor point, water on the floor is common, and any citation issued could trigger a repeat violation citation to companies with multiple facilities. ■

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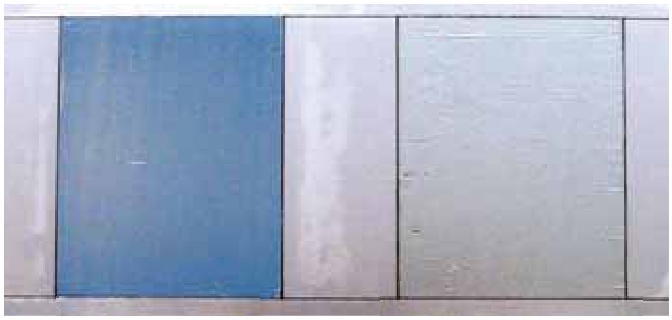
vs
Lithium Grease

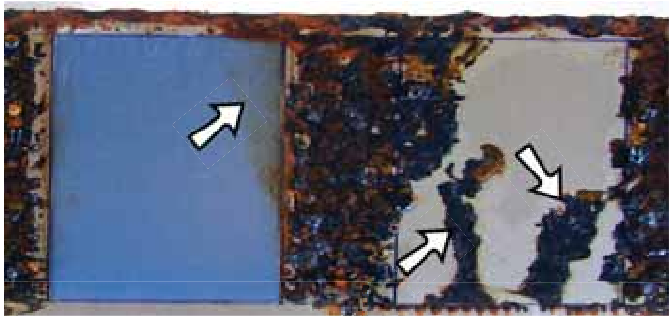
"ASTM B-117 salt fog lab test results show that RG-2400 works to prevent CUI and grease doesn't!"

Polyguard® RG-2400® LT (ReactiveGel®) and LITHIUM GREASE applied to blasted steel panel



RG-2400 LT LITHIUM GREASE

Steel panel after 168 hours in ASTM B-117 SALT FOG TEST



bleeding of corrosion onto RG Corrosion Undercutting

Steel panel cleaned off after panel came out of ASTM B-117 test chamber

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