Hillphoenix
Industrial Refrigeration

White Paper

Regulation of Industrial Refrigeration Equipment is Increasing. Here's How to Stay Safe and Avoid Increased Costs.

The US Environmental Protection Agency (EPA) states there are approximately 150 catastrophic accidents each year at facilities that make, use, or store extremely hazardous substances (EHS). With ammonia refrigeration making up approximately 40% of the facilities with EHS regulated under the EPA's Risk Management Program, these facilities appear to be coming under more scrutiny.

By ramping up enforcement, government regulators are doling out stiff penalties for violators. Here's a recent example.

In August 2022, the EPA announced a settlement with Ventura Coastal, LLC, to resolve Clean Air Act chemical risk management violations at its citrus processing facility located in Visalia,

California. ***It improperly managed refrigeration equipment containing more than 10,000 pounds of anhydrous ammonia and will pay $270,000 in civil penalties.***

After inspecting the Visalia facility, EPA determined that Ventura Coastal violated provisions of Section 112(r) of the Clean Air Act, which governs extremely hazardous substances such as anhydrous ammonia.

EPA found that the company failed to keep up-to-date information on equipment, failed to label piping and equipment, did not adequately describe maintenance and inspection frequencies for equipment and instrumentation, failed to inspect equipment and correct deficiencies, and did not address internal audit and incident investigation findings promptly.

The EPA says the settlement advanced its efforts to enforce environmental regulations that protect citizens from harmful releases of extremely hazardous substances, especially in communities that may already experience disproportionate environmental risks. Ventura Coastal's Visalia facility is in a community that is disproportionally affected by environmental burdens, and incidents like this raise significant environmental justice concerns.

Enforcement of Government Regulations is Increasing

EPA inspected Ventura Coastal's Visalia facility as part of the Agency's National Compliance Initiative, which seeks to reduce risk to human health and the environment by decreasing the likelihood of accidental releases and mitigating the consequences of chemical accidents. The goal of EPA's National Enforcement Compliance Initiative, underway since fiscal 2017, is to reduce the risk to human health and the environment by decreasing the likelihood of chemical accidents.

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In fiscal 2022, the annual number of EPA compliance monitoring activities and actions at facilities that use Extremely Hazardous Materials ramped up considerably. It renewed its presence in the field and increased its on-site inspections by more than 150% compared to fiscal 2021.

As a result, in fiscal 2022 EPA concluded three judicial actions, 145 administrative penalty actions, and 18 administrative compliance orders at industrial and chemical facilities.

New Compliance Challenges Facing Operators

An emphasis on stronger enforcement of existing regulations, along with new laws, could mean additional costs for operators in the near future. They are already required to develop detailed safety and training programs and an emergency response plan to meet these regulations. They must invest in personnel to develop and administer these programs, train their workers, buy liability insurance, and purchase eye wash stations and other equipment to keep employees safe.

To help refrigeration facilities comply with Clean Air Act, EPA is working to enforce four parts of the CAA's Chemical Accident Prevention Program:

- Risk Management Plan regulations;
- The General Duty Clause;
- The Emergency Planning and Community Right-to-Know Act and
- The Process Safety Management (PSM) regulations.

In addition, the Occupational Safety and Health Administration (OSHA) is considering possible changes to its Program Safety Management (PSM) Rules. While it has yet to propose updates, it held an informal stakeholder meeting in October 2022, to solicit comments on the scope of the current PSM standard, including expanding PSM coverage and requirements for reactive chemical hazards.

To help prepare, here is a summary of recent regulatory actions and those under consideration:

EPA Looks to Strengthen Its Risk Management Program (RMP) Rules. At the heart of EPA's enforcement is the requirement for operators to develop a Risk Management Program. The program includes the following"

- Hazard assessment that details the potential effects of an accidental release, an accident history of the last five years, and an evaluation of worst-case and alternative accidental releases scenarios;
- Prevention program that includes safety precautions and maintenance, monitoring, and employee training measures; and
- Emergency response program that spells out emergency health care, employee training measures, and procedures for informing the public and response agencies (e.g., the fire department) should an accident occur.

At the end of 2019, EPA had RMPs from about 12,000 facilities. The plans must be revised and resubmitted every five years. New facilities must submit a completed RMP as soon as they have a covered chemical above the threshold quantity.

The primary purpose of the RMP is to reduce chemical risk at the local level. The RMP information helps local fire, police, and emergency response personnel (who must prepare for and respond to chemical accidents) and is useful to citizens in understanding the chemical hazards in communities.

On August 31, 2022, the US EPA proposed to strengthen the RMP regulations with the Safer Communities by Chemical Accident Prevention (SCCAP) proposed rule. The goal is to further protect vulnerable communities from chemical accidents.

The rule provides greater protections for communities living near RMP facilities. It emphasizes the requirement for regulated facilities to evaluate risks of natural hazards and climate change, including any loss of power. It also requires safer technologies and alternative analysis for certain facilities with high accident rates and enhances facility planning and preparedness efforts.

Impact on Smaller Operators. The General Duty Clause is not a regulation and compliance cannot be checked against regulation or submission of data. It requires operators to identify hazards your facility may present from accidental releases of hazardous substances, design and maintain a safe facility, and minimize the consequences of accidental releases which do occur.

EPA states that operators should do the following:

- Adopt or follow any relevant industry codes, practices, or consensus standards (for the process or facility as a whole as well as for particular chemicals or pieces of equipment);
- Be aware of the unique circumstances of your facility which may require a tailored accident prevention program;
- Be aware of accidents and other incidents in your industry that indicate potential hazards.

For companies using 1,000 – 10,000 pounds of ammonia that fall under the General Duty Clause, EPA has been seeking to improve compliance. It has been sending Information Requests to select facilities that it believes may be out of compliance with GDC. Facilities are required to answer four questions about their ammonia refrigeration systems, including whether they have performed a process hazard review.

In the recent past, one EPA region sought to improve compliance without the need for inspections. It is requested that these operators identify and evaluate the potential hazards associated with their refrigeration system. However, if the operator has not done so, it must pay a $5,000 settlement. The company will also be required to conduct hazard reviews with expert help, meet with responders and file any missing EPCRA Tier II forms. Here are more details on this pilot program: EPA Region 1 General Duty Clause Pilot (ct.gov)

New Focus on the Start-Up Process. In February 2021, after finding that a disproportionate number of accidents occur during start-up or other nonroutine operations, EPA issued a new Enforcement alert. It cites the following provisions of the RMP regulations to prevent accidents during process startup:

- Operating procedures that provide clear instructions for safely conducting activities involved in each covered process.
- Training so each employee involved in operating a process is familiar with operating procedures, safety and health hazards, emergency operations, and safe work practices.
- Pre-startup review to ensure construction and equipment is functioning according to design specifications and that safety, operating, maintenance, and emergency procedures are in place and adequate.

In the immediate aftermath of an accident, local fire, police, and emergency responders are generally first on the scene to respond to the fire or chemical release. That is why it is important for them to have a facility's Risk Management Plan so that they are better prepared to respond to the hazards they might be facing.

The Chemical Safety Board investigates accidents to determine the cause or causes so that similar accidents might be prevented. The EPA would also investigate after an accident to determine if the facility violated Section 112(r) which might have led to the incident. If it was in violation, the EPA will compel the company to return to compliance and may assess a penalty.

Public Meetings Requirement – Possible Impact on a Company's Reputation. As of March 15, 2021, EPA now requires companies to hold public meetings within 90 days of a reportable accident that impacts people or property outside of its facilities.

Facilities regulated by an RMP must hold a public meeting following a reportable accident that has offsite impacts such as known offsite deaths, injuries, evacuations, sheltering in place, property damage, or environmental damage.

The owner or operator of the facility is required to provide a single notice (at minimum) to members of the public to inform them when and where the meeting will be held. During the meeting, the following information must be provided:

The chemical released and its date, time, and approximate duration; the estimated quantity released in pounds and, for mixtures containing regulated toxic substances, percentage concentration by weight of the released regulated toxic substance in the liquid mixture;

Weather conditions, if known; on-site and known impacts; initiating event and contributing factors if known; whether offsite responders were notified if known; and operational or process changes that resulted from an investigation of the release and that have been made by the time of the meeting.

The public meeting requirement will be enforceable by EPA and could result in monetary penalties and compel the convening of a public meeting. IIAR members should be aware that any RMP-regulated facility that experiences a reportable accident with offsite impacts after March 15, 2021, is required to hold a public meeting within 90 days of the incident. These meetings have the potential to harm a company's reputation. News stories or social media would amplify any missteps in the company's plans to prevent an accident or respond quickly to any emergency.

Alternative Solutions to Keep Facilities Safe

Ammonia-based systems have several benefits. It is widely used because of its low cost and thermodynamic efficiencies. But the increased regulation and enforcement activities have forced many businesses to look for safer alternatives.

Carbon dioxide (CO_2) has been making headway as a process cooling and industrial refrigeration solution. One answer to the rise in regulatory actions is to consider other refrigerants that are safer and eliminate ammonia's heavy regulatory burden.

CO_2 is a natural refrigerant that eliminates much of the regulatory burden associated with NH3. It is environmentally friendly. It is odorless and non-corrosive and does not deplete the ozone or harm food products when in direct contact.

It has a baseline of 1 for global warming potential and an A1 classification, so it can be safely vented and is non-flammable. From a regulatory perspective, there is no need for record-keeping or personnel to oversee compliance. There are no fines to pay for safety violations.

CO_2 systems are safe as long as they are used under the right conditions.

The materials and components of CO_2 systems are designed and manufactured to operate safely and efficiently at elevated pressures. The characteristics of its inherent operating pressure offer the additional benefit of utilizing the higher pressure to provide a higher volume of heat for heat reclaim and subsequent usage elsewhere in the facility. This feature results in overall energy cost savings for the processing facilities.

Because carbon dioxide systems provide sufficient heat for use in many heat recovery applications, they naturally lend themselves to heat pump duty, providing simultaneous cooling and heating. The reclaimed heat returned to a facility can be used to create hot water; thus, such an approach can offset a significant amount of fossil fuels that would otherwise be consumed in boilers. This results in an overall plant efficiency far better than traditional designs.

In general, the overall annual energy efficiency or refrigeration operating costs of CO_2 systems outweigh the cost of synthetic refrigerants (approximately 5 to 25 percent), but they are not quite as energy-efficient as ammonia (-2 to -10 percent). But, when the heat reclaim capabilities of CO2 are factored into the overall efficiency calculations, CO_2 will fare better than (or exceed the efficiency of) the other refrigerants. Many variables affect the difference:

- The low-side operating temperature (coolers, freezers, etc.).
- Ambient temperature. CO_2 is more efficient in northern climates than in southern climates.
- Refrigerant type (in the case of synthetics).

Another misconception is that CO_2 is expensive. CO_2 is readily available and inexpensive to produce and charge refrigeration systems when compared to many of the alternatives. Reduced pipe and component sizing, combined with the low cost of the refrigerant, contribute to cost savings on installation and an overall smaller equipment footprint.

Carbon dioxide's high volumetric cooling capacity can reduce costs because it allows the use of smaller pipes and compressors. Likewise, its high heat transfer characteristic leads to a reduction in the size of evaporators and condensers. Carbon dioxide equipment — like transcritical CO2 booster systems — has become far more commonplace in the industrial refrigeration industry.

Once a CO_2 system is in operation, servicing equipment is less expensive since CO_2 does not have to be captured and reclaimed (vent to open air). While ammonia-based systems are energy-efficient, the installed base of industrial refrigeration equipment using ammonia is beginning to show its age, which increases the possibility of corrosion to pipes and leaks. Companies considering replacing their equipment need to weigh the increased regulatory burden of ammonia as they consider this decision.

Finally, innovative technology such as CO_2 transcritical booster systems is sustainable and economical. CO_2 transcritical systems are now installed in thousands of installations throughout Europe and HillPhoenix's Advansor technology has a five-year track record with more than 500 installations.

Industrial Refrigeration systems have traditionally relied upon two refrigeration coolant technologies for decades. However, the Advansor transcritical booster system utilizes only one refrigerant— CO_2. All Advansor booster systems are carefully manufactured to achieve optimal, safe, and service-friendly operation. State-of-the-art oil control, flash gas control, and pressure regulation systems make it reliable and energy-efficient.

It provides the benefit already mentioned: It is a natural refrigerant and its higher quality heat reclaim opportunities improve store energy performance. It requires a lower CO_2 charge. It has a smaller weight and footprint compared to CO_2 secondary systems and it is more efficient than conventional HFC systems in many climates.

Financial Benefits of CO_2 Systems

Lower First Cost Savings/Total Cost of Ownership. In many cases CO_2 systems offer a lower first cost relative to NH3 systems, often as much as 25 percent less. CO_2 is readily available and affordable, ranging in cost from 50 cents to $2 per pound. Because of its lower operating costs compared to ammonia, a user can afford to keep spare CO_2 on-site for service purposes. Combined with its lower regulatory and administrative costs, CO_2 systems can provide the user with a lower total cost of ownership.

Flexible Installation. A Hillphoenix Advansor CO2 Booster System provides plenty of installation options. It can be roof-mounted, on a pad adjacent to a facility, in a mechanical room, or on a mezzanine. Because of the smaller sizes of pipes and other components, CO_2 systems often use 30-50 percent less space than those using ammonia. Because of these advantages, operators of many large industrial warehouses and small and medium-sized companies are turning to CO_2 systems.

Less Servicing Costs. Once a system is in operation, servicing equipment is less expensive since CO_2 does not have to be captured and reclaimed (vent to open air).

Tougher laws and stricter enforcement of safety and environmental regulations by federal agencies likely mean that operators with ammonia refrigeration facilities will likely continue to face increased costs. Those who fail to comply with federal and state regulations could even face civil penalties and fines. CO_2 systems offer a safe, cost-effective, and eco-friendly solution, especially when combined with the innovative technology and operational efficiencies available today.

The use of a CO_2 system in industrial applications makes it possible and practical for businesses of all sizes to build cold storage infrastructures, food processing environments, and warehousing and distribution facilities. With a team of experts trained to handle CO_2 for industrial refrigeration, businesses can adopt CO_2 systems safely and efficiently and the industry could realize huge gains moving forward.