Technical Paper #3

# Executive and Top-Level Management Team Introduction to the $NH_3$ System Process Safety Management Program

**Jet Tyson-Stiffler**
President
JS Compliance, LLC

**Abstract**

*The author interviewed several well-known top-level managers (some associated with large corporations) to provide management teams with information about ammonia refrigeration systems and how process safety management (PSM) affects their positions. Sincere thanks are offered to those individuals who cannot be named or publically recognized herein. Their input was invaluable.*

*At the end of this paper is a list of common acronyms and terms used throughout the industry in relation to PSM and risk management programs (RMPs).*

 

## Introduction

Today's constant governmental changes, interpretations, and updated regulations require executive and top-level management teams to be informed and educated about their responsibilities regarding the hazards in their organizations and facilities. Unfortunately for busy plant managers, the burden of compliance will continue to be significant with OSHA's Nation Emphasis Program (NEP) inspections, audits, and regulation changes related to the OSHA 1910.119 PSM program and the U.S. Environmental Protection Agency's (EPA) 40 CFR Part 68 Risk Management Plan. The goal of this paper is to provide executive-level leaders and site management teams an understanding of the requirements and their responsibilities with regard to the safety programs related to an $NH_3$ system.

Given the regulatory burdens, a good way to view forthcoming changes is to embrace them and take advantage of them. Doing so will not only result in the benefit of compliance with government regulations, but also better control and operation of a safer site for employees and neighbors. Numerous benefits will be realized, including more reliable equipment, better operating efficiency, and improved predictive and preventative maintenance of the ammonia refrigeration system. This allows for better long-term planning, which can avoid situational reactions that can end up costing money, time, and possibly the organization's reputation.

In the past, top-level management depended heavily on facilities' site safety management and refrigeration managers to ensure compliance. While this methodology appeared to be sufficient, and would be with most federal regulations, it has become more apparent that top-level authorities with decision-making responsibilities must understand PSM regulations sufficiently to make educated judgments about changes in processes and procedures.

A case in point concerns the recent indictment of a chief executive officer (CEO) who was found guilty of willful safety and health violations, which should get the attention of CEOs, chief financial officers, presidents, vice presidents, and plant-level managers all over the country. The following quotes from *National Geographic* are illustrative:

"The indictment of a former coal mining CEO over safety violations Thursday sent a 'strong message,' said the United Mine Workers of America. Don Blankenship faces four criminal counts and up to 31 years in prison for alleged safety violations at mines operated by Massey Energy, which he headed from 2000 until his retirement in 2010" (*National Geographic* 2014).

"The federal grand jury's indictment charges that 'Blankenship conspired to commit and cause routine, willful violations of mandatory federal mine safety and health standards at Massey Energy's Upper Big Branch mine, located in Raleigh County, West Virginia'" (*National Geographic* 2014).

Aside from potential lawsuits, lack of executive and top-level management leadership in establishing a viable and sustainable safety culture in their organizations and facilities can result in subordinates, contractors, vendors, and plant personnel all the way to the janitorial staff failing to see the need for safety excellence. This could lead to the possibility of multiple injuries and fatalities in the event of an $NH_3$ release.

OSHA has many general health and safety regulations. Industrywide, most facilities seem to have focused on occupational safety. While occupational safety is important to create a safe work place, sometimes facilities focus primarily on occupational safety, placing minimum emphasis on process safety management.

The difference between occupational safety and process safety is enormous and deserves discussion here. A process safety event has the potential to affect multiple people at a site and sometimes within a community all at one time. An occupational safety accident typically affects a single individual, or in rare cases, a small group of people. Significant process safety accidents (such as a catastrophic release of $NH_3$) occur infrequently, but can have undesirable and sometimes irreversible consequences, including loss of life and permanent property damage and destruction, such as that caused by the West Texas Fertilizer event. This type of impact will disturb people's views and emotions for the rest of their lives.

While these types of events may not be 100% preventable, their occurrence can certainly be substantially reduced, and every effort should be made to do so. Although the management team may consist of individuals who believe they know their responsibilities and feel that this information does not apply, individuals with the manager/management title have a heavy responsibility for the safe operation of the facility. In their defense, they may have done everything they *know* to do. However, an old saying goes "you don't know what you don't know." Once someone has been educated and has the knowledge and resources to make necessary changes, they are held to a higher standard. Furthermore, not knowing is not an acceptable excuse when it comes to the people's safety in OSHA's and EPA's world.

Occupational safety and process safety have other differences. For example, occupational safety accidents are easier to track and prevent with trends and indicators due to the nature of the incidents. A person will often see a sign at the gate of a facility or on a bulletin board such as that in Figure 1:


**Figure 1. OSHA sign indicating number of days without an accident.**

The figure illustrates that occupational safety accidents can be monitored by using the results of previous accidents and tracking trends to identify common indicators and prevent future occurrences. However, process safety accidents (such as a release of a toxic or flammable material), which occur rarely, are not easily tracked by performance trends for the purpose of predicting future exposures. In the case of process safety accidents, “lagging indicators” unfortunately do not provide a means of predicting major releases. Therein lies the problem. The management team must observe process safety management activities and prioritize activities based on indicators such as “red flags” that could cause a hazardous condition. An example is a process hazard analysis recommendation or a mechanical integrity inspection recommendation that is a Level 1 = High Priority action item.

Having some type of management approach to process safety is necessary to allow for the planning of needed resources and activities to prevent future events.

If an accident occurs, it is obviously too late to prevent it. The only hope is that people can learn from the event and take measures to prevent a similar occurrence in the future. Unlike occupational safety, a release of a highly hazardous material (such as ammonia) could and often does involve multiple injuries and fatalities during one event. Incidents at BP in Texas City and DuPont in La Porte, Texas, illustrate the differences between occupational safety and process safety. Both had reported excellent OSHA occupational safety programs. For at least two decades, DuPont, a chemical giant with $4.8 billion in annual income, had billed itself as a “world class safety leader” and was the original promoter of a so-called “zero injury culture.” This speaks to volumes of measurable matrixes that gave upper management an illusion that the facilities were operating safely. However, at the BP facility in Texas City in 2005, 15 people lost their lives, and at the DuPont facility in La Porte in 2014, four people lost their lives. In these cases, both companies overlooked a very important aspect, that is, process safety management. OSHA 1910.119 Process Safety Management Program is for the safety of the *process*. The *process* in a cold production and cold storage industry is the ammonia refrigeration system (or $NH_3$ system)—the piping, equipment, valves, relief valves, etc. In essence, PSM is designed to keep the chemical in the pipes.

It would be easy to assume that these companies should have known better, because they are large and have abundant resources. What must be realized is that if top-level management doesn't have the information needed to make educated decisions about their facilities' processes, a catastrophic event may occur.

Industry must make every attempt to protect employees, who are not only crucial to running our businesses, but are the family and friends of our communities. Again, the purpose of this technical paper is to ensure management teams are equipped to make the right decisions regarding process safety in their organizations and facilities.

This paper's topics of discussion include

- What are the differences and similarities between OSHA's PSM and EPA's RMP?
- Who is responsible for compliance with both PSM and RMP?
- When was the facility's last RMP submitted to the EPA and is the content still accurate?
- What determines if the facility is an RMP or a PSM site? How much ammonia does the system contain?
- Where are the RMP/PSM implementation documents kept at the facility?
- What should plant management look for and identify during a facility site tour of the $NH_3$ system?
- What is the emergency action plan, and what is the correct response in the event of a release?

## What are the differences and similarities between OSHA's PSM and EPA's RMP?

The OSHA 1910.119 Process Safety Management Standard (PSM) was made mandatory in 1992. PSM encompasses 14 elements that can be viewed as chapters in a book. Each element (or chapter) has specific requirements. The 14 elements are

- Employee participation,
- Process safety information,

- Process hazard analysis,
- Operating procedures,
- Training,
- Contractors,
- Pre-startup safety review,
- Mechanical integrity,
- Hot work permit,
- Management of change,
- Incident investigation,
- Emergency planning and response,
- Compliance audits, and
- Trade secrets.

Although the policies and procedures encompassed by these elements have been mandatory for years, executive and plant management personnel might not know their facility is required to comply with the PSM regulations.

After implementation of the PSM standard, the EPA's 40 CFR Part 68 Risk Management Program under the Clean Air Act was made mandatory in June 1999.

The risk management program requires facilities to have a risk management plan (RMP) with these five basic elements (or chapters):

- Organizational management system;
- Off-site consequence analysis (hazard assessment);
- Prevention program, which is covered by PSM compliance;
- Emergency response program; and
- RMP submittal to the EPA every five years.

Fortunately, the risk management plan elements for an ammonia refrigeration system do not add many requirements in addition to the PSM requirements. With the exception of these additional requirements, the RMP prevention program is exactly the same as the PSM's 14 elements. Therefore compliance with the PSM regulation fulfills compliance with the EPA's RMP prevention program. The additional RMP requirements are as follows:

- An organizational management system is required to indicate who is ultimately responsible for the facility.
- The worst-case scenario and alternative case scenarios must be performed for the off-site consequence analysis (hazard assessment).
- An emergency *response* program is required. Although similar to the PSM emergency action plan, it takes a step further to indicate who will respond and how a release will be mitigated.
- An RMP submittal is required to be sent to the EPA at least every five years.

## Who is responsible for compliance with both PSM and RMP?

Under the EPA's RMP standard, the management system provides information to the EPA regarding who is ultimately responsible for ensuring that all PSM and RMP elements are managed and that the facility is compliant.

It takes the form of a simple organizational chart that lists individual roles and responsibilites and implies a magnitude of weight upon the shoulders of those individuals. This is the reason executive management should be familiar with both the RMP and PSM requirements. When changes occur among the organizational staff, those changes must be reflected in the RMP's management system element.

## When was the facility's last RMP submitted to the EPA, and is the content still accurate?

A good practice for the executive management team is to review when the latest RMP was submitted to the EPA. The RMP must be updated and resubmitted to the EPA at least every five years. The site safety manager or environmental manager should be able to provide a hardcopy version of this document. It is normally kept in a binder with the backup documentation for the RMP submittal. The responsible party named on the submittal is the person with the ultimate authority and responsibility for the plan. Therefore, the executive management team should know what was submitted to the EPA on behalf of the organization and/or each facility and be sure it is accurate.

In the event of a major release, the information in the RMP submittal is provided to local responders and authorities. It provides responders the information they need to know, such as how much ammonia could be released and how many people in local homes, schools, shopping centers, and industrial areas may need to be evacuated.

## What determines if the facility is an RMP or a PSM site? How much ammonia does the system contain?

The OSHA website (https://www.osha.gov/SLTC/processsafetymanagement/) is a good source of information and provides the OSHA 1910.119 Process Safety Management Standard. Appendix (A) of the standard lists the covered highly hazardous chemicals and their threshold quantity requirements. Anhydrous ammonia ($NH_3$) is on the list and has a threshold quantity of 10,000 lb. Therefore, if a process within a facility has 10,000 lb of ammonia or more, it must comply with the OSHA PSM and RMP requirements.

In addition, if a facility has two or more separate processes within its fence line with systems that are not interconnected, e.g., two separate systems that contain 6,000 lb. of ammonia for a site total of 12,000 lb, it may or may not be subject to PSM and RMP. A facility site analysis may need to be conducted to determine whether a possibility exists that an accident or an upset of one system could affect the other system. A common factor to consider is the relative physical location of separate systems. Two systems that are located next to each other, or that share a common machinery room, would typically comprise a situation where one system could affect the other. However, two separate systems on opposite sides of the building would typically be considered a situation where they would not affect one another, or contribute to an additive release because of some external issue.

If a process does not meet or exceed the threshold quantity, it must still comply with certain governmental regulations. The facility has an obligation and requirement to meet safety guidelines under both OSHA's and EPA's general duty clauses. This can be achieved by following IIAR's *Ammonia Refrigeration Management (ARM) Program* (1995).

The plant management team should determine how much ammonia is at the site. The previously discussed RMP submittal will have the quantity of ammonia listed under the chemical inventory. However, this can and should be verified by reviewing the ammonia inventory calculations that are kept in the process safety information. The plant's refrigeration manager or engineer should be able to locate the calculations.

The ammonia inventory calculation should be current. To verify the information is up to date, plant management should ask the PSM team leader or refrigeration manager for the last management of change (MOC) that was done to reflect the addition of equipment or pipe in the ammonia refrigeration system. The ammonia inventory calculation should list all vessels, compressors, condensers, evaporators, and piping, giving a number that indicates the volume that each component might contain at any given time. If the calculation appears to be old and outdated, or if information is missing (e.g., the piping is not included), an updated ammonia inventory calculation will be needed for the PSM program.

The ammonia refrigeration system is a closed loop system and is maintained at a certain charge level. Occasionally when the system falls below normal operating level, the system must be charged. Ammonia will be brought in to the facility, typically via a truck or trailer. Written procedures known as standard operating procedures (SOPs) instruct operations personnel and the truck driver in how to deliver and charge the ammonia safely. The delivery receipts will provide the total volume that was delivered. This information can be used to determine if the amount of ammonia being delivered is substantially high compared with how much is lost due to daily purging operations and minor leaks. This is the information that is submitted to the EPA on the RMP submittal, and therefore, *it must be accurate*.

## Where are the RPM/PSM implementation documents kept at the facility?

Maintaining the PSM library in a controlled environment is vitally important. Some documents may be duplicated and provided for use in certain areas of the facility, but the governing document should be kept in a secure location.

The PSM team leader should know where the documents are kept and keep them in an organized filing system (i.e., PSM library). The program policy and procedures and the backup documentation may be kept as electronic files. It is of the utmost importance that everyone on the PSM team has access to the PSM library. The program should not be kept under lock and key of one individual. It is a team effort and falls under management's responsibility.

Another key concern to consider in determining a safe location for the PSM program documents is the possibility of a plant-wide event such as a fire, tornado, hurricane, or other disaster. This type of disaster could destroy any evidence that could be used to defend top-level executives in litigation if needed. Proving innocence to PSM- and RMP-related charges without the documentation of proof that comes with a performance-based program would be difficult. Look at the West Texas Fertilizer event or the destroyed Bonneville, Arkansas, facility. The possibility exists that the evidence they needed to defend their cases may have been lost along with numerous other important documents.

## What should plant management look for and identify during a facility site tour of the $NH_3$ system?

The plant management team should take a tour of the ammonia system with a guide, preferably the site's refrigeration engineer/manager. The guide should know the ammonia system and be able to explain how the system works and answer any questions relative to the system. He or she should introduce the other refrigeration personnel (engineers/operators) in the facility and explain each of their roles in the ammonia system.

This is a good time to become acquainted with the refrigeration technicians and determine how long they have worked at the facility and how much industry experience they have operating a chemical process. This provides the plant management team with the basis for allocating materials and resources for additional training and/or off-site refrigeration education.

The site tour should begin with a basic document review. The guide should point out the different areas of the facility that will be visited on the tour by using the block flow diagram and piping and instrumentation diagrams (P&IDS). The P&IDS are an accurate and up-to-date illustration of the ammonia refrigeration system. They are drawings of all components in the system, showing the compressors, condensers, evaporators, vessels, pumps, control valves, relief valves, and piping system.

Things to observe while reviewing the documents include

- The ammonia refrigeration system P&IDs and a block flow diagram;
- A list of the recommended and generally accepted good engineering practices (RAGAGEP) the facility follows for the design, operation, and maintenance of the system;
- The $NH_3$ system's standard operating procedures;
- The ammonia inventory calculation(s), including receipts of recent purchases of ammonia; and

- The safety data sheets (SDS) for anhydrous ammonia (to be familiar with the hazards of $NH_3$).

There may be additional documentation to review along the way or at the end of the tour. The following sections discuss areas to review during the site tour.

*Machinery room*

The tour should start in the machinery room, which is sometimes called the compressor room or the engine room. The machinery room will have

- Ventilation fans. Air intakes are normally located on the ceiling. Ensure they are operating. Ask to see the ventilation calculations. This document provides information for determining if the ventilation system is adequately sized for the room. Ask the guide or engineering manager to explain the calculation formula if needed. These calculations should conform to the RAGAGEP used when the system was designed or modified.
- Ammonia sensors and alarms. Ask if the sensors and alarms are working properly and when they were last tested. Ask how often they are tested. There will be documentation on the test results. Knowing the sensors and alarms are operating properly and are tested at the appropriate frequency based on the manufacturer's recommendations is important.
- Emergency stop switches. An emergency stop switch (ESS) should be located and labeled outside of the principal machinery room door. This switch should be outside, not inside the machinery room, and each principal exit door must have one. In the event of a major ammonia release, the ESS will shut down all the compressors and remove power from normally closed automatic valves within the machinery room. The ESSs must be tested at least annually. Ask for the documentation that indicates the last testing of the ESSs and ensure they are functioning properly.

- The emergency ventilation switch. An emergency ventilation switch should be located and labeled outside the principal machinery room door. In the event of an emergency this switch can be manually activated to force the ventilation fans on. The ventilation system must be tested according to the maintenance schedule in both the automatic and manual modes.
- Pressure relief valves (PSVs). PSVs are considered a safety component and can prevent the $NH_3$ system from overpressurizing. PSVs are required for all pressurized vessels, such as the high-pressure receiver, accumulators, compressor oil separators/oil coolers, oil pots, and other equipment. The PSVs should have an installation date stamp, and the replacement date should not exceed five years. Ask to see the newest relief valve list with the replacement schedules. This is an IIAR recommended practice. Failure to replace PSVs in the allotted time may result in a catastrophic release of $NH_3$ and possible OSHA and EPA fines during an inspection.
- Pressure relief vent system calculation. This document includes calculations of the PRV system to determine that it is adequately sized. The calculations will include the size of each PSV in the system, the size of each branch of the relief piping system, and the size of the pipe header (if used) that is routed to the roof. IIAR standards require that relief headers terminate at least 7.5 ft above normally unoccupied roofs or platforms and 15 ft above the grade or regularly occupied working surfaces. The location of the air intakes and fan vents are also included in the calculations to prevent employee exposure to $NH_3$ during a release.
- Compressor's control panels. Each compressor has safe operating limits (e.g., high and low discharge pressure, suction pressure, oil temperature, etc.). Ask the guide how often the safeties on the compressors are tested and if they are working properly. They should be tested at least annually, and the tests should be documented. Again this is a very important test and requirement. If the level, pressure, or suction is exceeded during operation, the compressor cut-outs or safeties will automatically activate and shut the compressor off. During a process upset or an emergency situation the compressor safeties must function according to their design intent.

- Overall engine room cleanliness. A clean engine room indicates that the system is well maintained and operated. In contrast, if the engine room has oil on the floor, hoses hanging from the compressors, trip hazards on the floor, and similar evidence of disarray, a need exists for further investigation into the overall operations of the system (review the standard operating procedures and the preventative maintenance program).

Additional items to observe during the tour of the machinery room include

- Evidence of corrosion on noninsulated vessels, piping, and supports;
- Iced or moldy insulation, which indicates ineffective insulation and possible pipe corrosion under the insulation;
- Damaged and/or missing insulation and insulation deals;
- Paint chipping/failing or lack of paint on equipment and pipe;
- Condition of line identification markers and valve tags; are they readable, faded, or hard to see from a distance?
- Open-ended pipe, such as oil drains, which should be capped or plugged; open ended pipe is not acceptable; and
- The location and proper functioning of eyewash/shower stations; pull the chain to see if they work properly.

*Roof*

The plant management team should ask the guide to go to the roof. Making this effort will demonstrate to plant personnel that management is serious about the safety of the facility's ammonia system. The following should be found on the roof in most cases:

- The condensers,
- Pipe headers (long runs of pipe from the machinery room through walls and/or ceilings and up to the roof),
- Valve control stations,
- Penthouse units (if applicable), and
- Pressure vessels (if applicable).

Once on the roof, the plant management team should observe the following:

- Evidence of corrosion on noninsulated vessels, piping, and supports;
- Iced or moldy insulation indicative of ineffective insulation and possible pipe corrosion under the insulation;
- Damaged and/or missing insulation and insulation seals;
- Chipping/failing paint or lack of paint of equipment and pipe;
- Condition of line identification markers and valve tags; are they readable, faded, or hard to see from a distance?

In most facilities the pipe that distributes ammonia throughout the facility is located on the roof. In years past, the pipe could have been located inside in the production area ceilings. If the pipe is located on the roof, plant personnel exposure is reduced. However, locating the pipe on the roof is not a RAGAGEP requirement, it is a management team preference that allows executive management at the corporate level the opportunity to get involved and ensure all of the organization's facilities are designed and built to a higher and safer standard.

*Outside areas*

The guide should continue to the outside areas where pressure vessels or other equipment may be located.

*Pressure vessels*

Many ammonia refrigeration systems have a high-pressure receiver, which is often located outside. It is the main ammonia vessel and has several valves on top. Most often a "king valve" will be located near the receiver. If a king valve is present, ensure it is identified with a sign. This is the main (manual) shutoff valve to be used in the event of an emergency release of ammonia. Some systems with newer designs have automatic solenoid valves or hand valves in the machinery room for stopping the flow of ammonia. The shutoff valves *must* be clearly identified and easily accessed. If the king valve is on top of the receiver, confirm a platform or a dedicated ladder is available for easy access to the king valve in the event of an emergency.

Each pressure vessel (surge drums, accumulators, oil pots, etc.) should have a National Board name plate attached, which should be exposed and readable. The name plate provides the name of the vessel's manufacturer, the National Board number, serial number, and the date the vessel was built.

The pressure vessel manufacturer data reports must be obtained from the manufacturer or the National Board of Boiler and Pressure Vessels and be made available at the site, preferably in the PSM library. This is a part of the process safety information required by OSHA and EPA.

Oil draining from a vessel is a source of many ammonia releases due to human error. Most facilities have opted to add quick-closing valves (sometimes called dead-man valves) to the end of the oil drain to help prevent personnel exposure to ammonia. Ask the guide to point out the oil drains' quick-closing valves and quiz the guide on the procedures. This procedure should be second nature to operators because they drain oil from oil pots on a regular basis as part of the maintenance program.

*Production or storage areas (inside the plant)*

Air units (also called air handlers or evaporators) most often hang from the ceiling in the production area, cold storage rooms, and freezer areas. The following can be identified as potential hazards:

- Low-hanging pipe and/or evaporators that could be affected by forklift operations;
- Evidence of corrosion on noninsulated vessels, piping, and supports;
- Iced or moldy insulation, which indicates ineffective insulation and possible pipe corrosion under the insulation;
- Damaged and/or missing insulation and insulation seals;

- Chipping/failing paint or lack of paint of equipment and pipe; and
- Condition of line identification markers and valve tags; are they readable, faded, or hard to see from a distance?

In addition, other equipment can also be referred to as evaporators or refrigeration system equipment. These might be spiral freezers, water chillers, scraped surface heat exchangers, jacketed tanks, etc. The same observations made previously should be made for this type of equipment also.

*Hidden locations of ammonia piping*

Hidden areas in the facility with ammonia piping may exist, such as piping in ceiling crawl spaces, run down walls between floors, etc. Ask the guide to point out these locations. This pipe *must* not be forgotten during routine inspections and maintenance activities.

*Confined spaces*

Confined space areas may or may not exist in an $NH_3$ facility. The plant management team should ask if any areas have been identified as a confined space because special permits and standard operating procedures are required for entering such a space.

*Maintenance shop*

The tour may also include a walk-through of the maintenance shop. The plant management team should note the location of the battery charging areas and where hot work is permitted without a hot work permit.

  

*Tour conclusion*

Completion of such a tour will enable the plant management team to become familiar with a facility. The plant management team should not hesitate to ask the guide questions; after all, he or she is the ammonia specialist at the site. As a result of a tour, the plant management team should have become educated enough to ask questions regarding the safe operation of the ammonia system as related to OSHA 1910.119 Process Safety Management and EPA 40 CFR Part 68 Risk Management Plan. In addition, the plant management team should be able to answer any questions about the facility regarding PSM and the $NH_3$ system for the executive-level leaders.

## What is the emergency action plan and what is the correct response in the event of a release?

The OSHA PSM and the EPA RMP were designed to prevent a catastrophic release. However, the possibility of a release of ammonia due to equipment failure or human error always exists. Management should ask the safety manager for the current emergency action and response plan. The emergency action plan is a requirement of OSHA's PSM regulations, while the emergency response plan is a requirement of the EPA's RMP regulations.

The plant management team should become very familiar with the content of each plan. Some areas may need to be changed in relation to emergency evacuation, alarm notifications, response procedure responsibilities, etc. Some facilities choose to have select trained personnel as first responders. This is called a HAZMAT team, and it responds to and controls ammonia leaks and releases. If the facility does not have a HAZMAT team, there should be coordination with the local emergency responders to assist during an emergency.

  

The plant management team should ensure that the facility regularly coordinates drills for an ammonia release. The drills should include a mock drill with the local responders. The emergency action plan should indicate that the facility participates in and plant personnel are members of the community's local emergency planning committee (LEPC). The LEPC can provide valuable information for responding to emergencies.

## Conclusion

In an ammonia refrigeration facility, the executive-level and plant management team members ensure the safe operation of the system to prevent a catastrophic release and personnel exposure to $NH_3$.

A catastrophic release of ammonia could result in OSHA and EPA citations, litigation fees, potential jail time if negligence can be proved, loss of product, loss of customers, and loss of employees and the company's reputation. Employees should be made to understand that their jobs depend on the facility's good reputation and profitability. It is noteworthy to consider that when someone mentions BP the first thing that comes to mind is the BP Deepwater Horizon oil spill or the BP Texas City explosion.

Improving facility safety begins with the executive management team providing resources and leading the way to change the organization's and the facility's safety culture. Everyday small changes can be realized that will improve the overall safety of the facility, including

- Budgeting for the preventative maintenance program to ensure replacement of equipment and components prior to failure,
- Budgeting for better operator training programs,
- Budgeting for technical and control system improvements to the ammonia system,

  

- Budgeting for personnel and funds allocated to complete process hazard analysis action items, and
- Budgeting for personnel and PSM team time to ensure that the PSM program is kept current and maintained.

And last but not least, the executive management team leads and drives the safety culture for the organization by

- Having lunch-and-learns,
- Implementing recognition and awards programs,
- Having regularly scheduled PSM team meetings,
- Sprinkling PSM into conversations, and
- Sharing safety moments.

With these provisions, executive management teams can enjoy the comfort of knowing the ammonia refrigeration system is operating safely and efficiently and is more reliable. Facilities can continue operations without unplanned downtime and realize cost savings on a more efficient refrigerant system, and the employees can deem the site a good place to work.

## References

*National Geographic*. (2014). Christina Nunez, "The Great Energy Challenge – Former Coal Mining CEO Faces Prison Over West Virginia Safety Violation." November 14, 2014, http://energyblog.nationalgeographic.com.

*Ammonia Refrigeration Management Program (ARM)*. Alexandria, VA. IIAR. (1995).

## Common PSM-Related Acronyms and Abbreviations

| | | |
|---|---|---|
| EPA | = | U.S. Environmental Protection Agency |
| MI | = | mechanical integrity |
| MOC | = | management of change |
| $NH_3$ | = | anhydrous ammonia |
| OSHA | = | U.S. Occupational Safety and Health Administration |
| PRV | = | pressure relief valve |
| PSM | = | OSHA's process safety management |
| RAGAGEP | = | recognized and generally accepted good engineering practices |
| RMP | = | EPA's risk management plan |
| SOP | = | standard operating procedures |

## Notes: