

TECH TIP



Efficient and Effective Incident Investigations

Ammonia, a versatile toxic compound, is one of the most widely used refrigerants, and is one of the world's most produced chemicals with a global industrial production of approximately 172 thousand tons in 2019 alone^[1]. Since the introduction of first-generation refrigerants in the 1830's, industry has adapted to revelations in safety and environmental hazards associated with using anhydrous ammonia as a cooling medium. Despite using inherently safer design philosophy and conducting risk assessments, problems and failures leading to releases of this toxic substance still occur frequently. When accidents occur, incident investigations using root-cause analyses are tantamount to operating safely alongside to understanding the inherent risks of the essential compound.

Why use ammonia? Ammonia has thermodynamic properties ideal for the refrigeration industry. Historically, hydrofluorocarbons have been the dominant choice of refrigerant until their association with the ozone depletion, which triggered their phase-out in a set of regulations under the Montreal Protocol, alongside other refrigerants with potential for ozone depletion, global warming, greenhouse gas emissions, and carbon emissions. In a second set of regulations under the Kyoto Protocol, the potential for global warming caused by hydrofluorocarbon refrigerants drove a universal interest in environmentally friendly chemicals for refrigerants, including ammonia. Ammonia is a desirable refrigerant because it has zero Global Warming Potential (GWP) and Ozone-Depleting Potential (ODP), making it an optimal choice for refrigeration. It is a hazardous substance but using safety measures enables effective global utilization in industry^[2].

Who is required to investigate releases of ammonia? At the federal level, OSHA's^[3] Process Safety Management and EPA's^[4] Risk Management Plan regulations require that facilities conduct incident investigations for accidental releases of ammonia. These regulations illuminate the essential need to learn from these incidents by investigating the incident for information about site hazards and patterns to prevent future accidental releases. The immediate cause of an incident is often the result of a series of other problems that need to be addressed to prevent reoccurrence, such as poor training, for example, which would be passed over without a thorough investigation.

What is an incident? Investigations must occur for each incident which resulted in, or reasonably could have resulted in, a catastrophic release of a regulated substance. A catastrophic release is one that presents an imminent and substantial endangerment to public health and the environment. Investigating near misses and minor accidents is also helpful in identifying problems that could lead to more serious accidents. A near miss is an event, which did not result in injury, illness, or damage, but had the potential to do so. By investigating these less severe incidents, the underlying causes for a more severe incident can be eliminated.

Resources

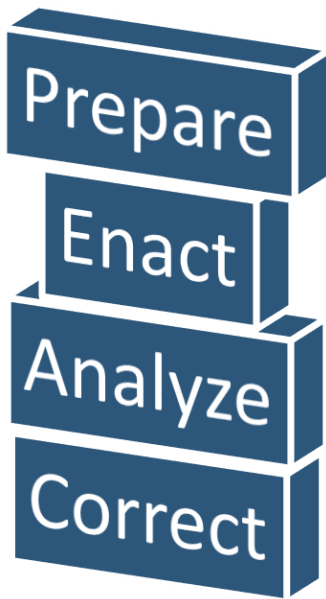
Ammonia Market
[Ammonia Supply](#)^[1]

Environmental Affect
[Refrigerant Choice \[Awari et al., 2013\]](#)^[2]

Regulatory References
[EPA RMP Regulations](#)^[3]
[OSHA PSM Regulations](#)^[4]



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How should one investigate? Although investigations are unique to each facility and process, they begin with a simple set of procedures. Investigations must begin within 48 hours of the incident. It is helpful to designate responsibility for compiling initial incident data and putting together an investigation team. Investigations often proceed more smoothly when the team is comprised of personnel who have been trained in accident investigation methods and facility-specific procedures. For smaller facilities, for example, the “team” may be one person who works with local responders. Once a team is developed, the factors contributing to the incident are identified.

Identifying the root cause of an incident is often more important than identifying the initiating event or failure. Root cause analyses prevent recurrence because the process of identifying what, how, and why something happened defines the mechanism of an accident. The steps leading up to the incident and conditions surrounding these events are recounted in this step, enabling investigators to identify gaps and deficiencies in knowledge. Once all the steps have been identified, root causes, or underlying, reasonably identifiable factors that can be controlled by management to allow for general recommendations, are identified. Do not stop at the obvious initiating event, or failure – instead, try to determine why the failure occurred. For example, when an operator’s mistake is attributed as the event, one should determine if the operator’s mistake derives from inadequate training, training on the wrong procedure, or due to design flaws that increased risk. Internal and external sources should be tapped when conducting the investigation. Operators in the area during the time of the accident and maintenance records provide insight of incident condition and events. In some cases, the investigation may involve consultation with outside resources. For example, in the event that the equipment failed in an unusual way, one may need to consult the manufacturer and/or trade association to determine if similar equipment experienced similar failures. The findings are then summarized in a report with recommendations to correct any identified vulnerabilities.

Incident investigations are closed with the documentation of the final report’s findings, distribution of the findings to affected employees, and closure of recommended corrective actions to prevent future occurrences. The final report, including its recommendations must be shared with affected workers whose jobs are relevant to the incident. The recommendations are required to be promptly addressed, with their resolution documented. And finally, the report must be retained for 5 years. It is important to note that the objective is not to blame, but to prevent accidents and correct problems, thus preventing recurrence.

About the Author:

Mr. James de Graw is a Project Engineer with Risk Management Professionals. He has supported a variety of activities associated with the California Accidental Release Prevention Program (CalARP), Environmental Protection Agency’s Risk Management Plan (EPA’s RMP) and Occupational Safety and Health Administration’s Process Safety Management (OSHA’s PSM) Program and specializes in Program Development and Five-Year Updates in compliance with current regulatory standards.

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