Risk Management Exercise & Practice Lab

Anasua Ghosh

Old Dominion University

MPH 632: Environmental and Occupational Health Risk Assessment

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Dr. James Blando

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Introduction

Residential proximity to the major chemical production facilities puts residents at risk. About 177 million people in the United States live near over 12,000 high-risk chemical plants all over the United States that use or store dangerous chemicals with an elevated risk of industrial chemical catastrophes. The hazardous chemical can cause acute health hazards, injuries, fatalities, or even death and can contribute to serious long-term health issues like cancer. In addition, releasing hazardous chemicals into the environment can cause serious harm to the ecosystem, causing degradation of water and soil and killing animals and plants.

In the given scenario of the mid-size city in the Southeast, the use and storage of very large quantities of MIC by one of the chemical facilities is a significant concern for the safety of the residents and the workers of the chemical manufacturing facilities. This paper identifies the opportunities to minimize or eliminate the risk associated with the scenario and suggests risk management recommendations to ensure safety and security for workers, residents of the local community, and the environment.

Risk Management Recommendations

- Adopt approaches related to the safe use and storage of methyl isocyanate.
- Review the current industry practice for MIC use and storage, including critical points and guides.
- Identify approaches for eliminating or reducing the use and storage of methyl isocyanate.
    - Adapt an alternate process that does not require the use of MIC.
    - Reduce the volume of storage of MIC.
    - Adapt an alternative production process where MIC would consume immediately during the process, so there is no need for onsite storage.
    - Estimate a cost comparison of the use of the alternate procedure.
- Adopt emergency planning, response, and communication procedures in the facility.
- Review current industry practices and technologies for producing carbamate pesticides, including carbaryl, aldicarb, and related compounds.
- Assess fire and explosion hazards within the facility, prepare a fire and explosion prevention plan, implement it, and monitor its effectiveness.
- The sludge and bottom of the pesticide production process are hazardous waste and must be transported, stored, or disposed of following hazardous waste management guidelines.
- Adopt a hazardous material railroad transportation guideline to reduce the risk of rail transportation in the scenario city.
- Provide regular health checkups of the residents' lives in close proximity.

Detailed of implementation of recommendations and justification

Safe use and storage of methyl isocyanate (MIC)

Process safety management is a systematic approach to controlling hazards and supporting organizational safety culture and practices. Methyl isocyanate (MIC) is a highly reactive, volatile, and flammable chemical used as an intermediate chemical in carbamate pesticides production. Methyl isocyanate can cause highly toxic inhalation hazards to humans, injure the lungs and bronchial airways, and cause permanent eye damage and death. Using and storing very

large quantities of MIC can cause a claustrophobic accident. About 744,000 people live near the facility, and a large number of people work nearby. Any accident in the pesticide plant can cause massive casualties. Therefore, the chemical facility shall adopt process safety management requirements to use and store methyl isocyanate (MIC) safely.

OSHA Process Safety Management Program standards which apply to 137 toxic chemicals, including methyl isocyanate, guide management about the requirements to reduce or minimize the hazards associated with highly hazardous chemicals. The PSM standard, which has fourteen mandatory elements, requires a careful review of hazards to perform an initial process safety management(PHA) and to revalidate the PHA at least every five years. In addition, the standard requires documented details of necessary procedures that integrate technologies, procedures, and management practices.

The EPA Risk Management Program (RMP) implemented Section 112(r) of the Clean Air Act amendments of 1990, which regulates the use and storage of highly hazardous chemicals. The facility management has to develop a plan to prevent accidental releases of these substances and ensure that the industry and adjacent communities can respond effectively in case of a release. The plan must revise and resubmitted every year to EPA.

Therefore, the chemical facility of the mid-size city should establish and implement either PSM standards or RMP or both for the safe handling of MIC.

<u>Here are a few regular safety procedures to follow by the facility</u>

- Develop and maintain a safety and health data sheet detailing health and safety considerations for hazardous chemical use.
- Develop and maintain an information sheet about the technology used in different processes.
- Develop a written operating procedure document of the facility, including details of chemical processes, risks and limitations, and safety and health considerations.
- Perform a hazard assessment regularly with details of potential sources of accidental releases of hazardous chemicals, particularly MIC, estimation of the potential effect of accidental releases within the facility, estimation of the range of potential accidental releases, effect on employees, estimation of the effect on surrounding communities with guidance from the previous similar facility accident references (Bhopal disaster, India).
- Process hazard analysis should complete every five years.
- Establish a hazard assessment team who will deal with the workplace hazard assessment and the prevention, mitigation, and management strategies.
- Perform ongoing safety reviews for design changes and operational reviews for all process changes.
- Provide regular training to all the employees, including contractors and contract employees, with particular emphasis on safety procedures and hazard identification.
- Provide culturally competent training for all workers.
- Ensure proper maintenance of all process-related equipment and that all parts are fabricated and installed correctly, consistent with design specifications.
- Management of aging plants involves special workforce training, rigorous maintenance, and inspection.
- Even recommended changes in safety process design can reduce the risk of MIC accidental release, including an emergency dump tank for the safe transfer of MIC, a scrubber to destroy MIC in the storage tank, a flare tower to destroy MIC from process vents, MIC leak detection alarms, a diesel generator for backup power, seal-less pumps for managing liquid MIC, fire protection for pipe rack transfer lines and many more.

Here are a few MIC-specific safety procedures to follow by the facility

- Prior to the MIC handling, you need to be trained in the procedure.
- Methyl isocyanate shall store to avoid contact with water, strong acids, alkalis oxidizing agents, and any reactive chemicals.
- Area where the MIC is used shall be well ventilated using local exhaust or ventilation.
- MIC shall store in a dry, cool, well-ventilated area away from heat and sunlight.
- Any sources of ignition should not be close to MIC during handling, use, or storage.
- Metal containers involving the transfer of methyl isocyanate should be grounded and bonded.
- Fire and explosion protection should be used while handling.
- Use of engineering controls and personal protective equipment while managing MIC.

Here are a few good practices related to risk reduction of any hazardous exposure:

- If a chemical spill happens in clothing and clothes are contaminated by the hazardous chemical, the worker should change into clean clothing immediately.
- The workers should not take contaminated work clothes home, as family members should not be exposed to any hazardous chemicals.
- Contaminated clothes should be laundered after proper risk communication to the laundry.
- An eyewash station should be installed in the immediate work area for emergency use.
- Shower facilities should be provided if there is any risk of skin contact.
- Accidental skin contact with hazardous chemicals requires a quick wash of your body part to remove the chemical.
- A shower is necessary after every work shift to wash any area of the body that may have contact with the chemical.
- Workplace controls and personal protective equipment are necessary to handle hazardous chemicals safely.
- OSHA requires every employer to select the appropriate personal protective equipment for each hazard by trained individuals and to train employees on how to use personal protective equipment

The inherently Safer Processes approach is another valuable risk management technique the chemical facility can adopt. Inherently Safer Design presents a comprehensive approach applied to the design and operation process, first introduced in 1960 by Trevor Kletz. The chemical manufacturing process can be made safe if we reduce or eliminates the risk present with materials and operations used in the process. The method avoids hazards instead of controlling them by adding protective equipment. The method is based on an informed decision process. The pesticide company can reduce the MIC storage amount to reduce the risk. An underground double-walled storage system is a safer option for storage. Instead of storing one year supply company can store a 2–3-month supply in the underground storage system. The main drawback is that reducing MIC storage may impact carbamate production and increase the risk of potential MIC release.

For the elimination or reducing the use and storage of methyl isocyanate, an alternative chemical process not involving MIC should be considered. A non-MIC-based process produces an intermediate chemical with low purity, which can negatively affect the final commercial product characteristics. Therefore, an alternative production procedure for MIC can be considered.

However, the alternative processes that produce MIC in the gaseous form will require a re-designing of the facility and final product with a low quality.

Emergency management and preparedness

Prior planning and a robust industrial emergency management system is the key to successfully managing any accidental release of a hazardous chemical.

- Establish an emergency management system following National Incident Management System (NIMS) protocols to respond to emergencies.
- Provide regular training to all the employees, including contractors and contract employees, about emergency response procedures.
- The emergency management system shall create a comprehensive emergency response plan with the facility emergency response team and local community emergency response team.
- A robust risk communication tool for all levels of people should deliver honest and regular updates during any emergency will improve awareness and mitigate barriers in communication.
- A positive relationship between a facility and surrounding community residents allows for open discussion about risks and responses. A positive relationship helps to develop a sense of trust between the two parties. Trust gives confidence that the facility management is careful about the resident.

Carbamate pesticide production risk management

Carbamate pesticides, with the common name Carbofuran, is a hazardous chemical; appropriate personal protective clothing, appropriate eye protection, gloves, face shields (eight-inch minimum), and other PPE is necessary while handling. Carbofuran should be handled with proper exhaust and ventilation or with personal breathing protection. A collection of personal and air samples is necessary for routine evaluation by the employer. Risk management will include all work practices related to reducing hazardous exposure.

Fire and explosion risk management

Fire and explosion risks during production should be mitigated to prevent accidents. Evaluate the risk of fire and explosion and identify the employees who are at risk. Provide suitable personal protective equipment for all the employees who are at risk. The facility shall be classified into different zones according to the temperature and presence of explosive and flammable gases. All potential ignition sources, including sparks, hot surfaces, smoking materials, and naked flames, should remove from marked dangerous zones. Use non-sparking tools and equipment, explosion-proof electrical equipment, and fittings. Fire safety training should include in facility regular training material. Fire safety arrangements should include plans and procedures for safety drills, warning and other communication systems, and first-aid facilities.

Hazardous waste management

The bottoms and sludge of the given chemical facility should be considered hazardous waste and discharged and disposed of following industry regulations. Burial in the landfill or pit disposal, chemical treatment of the waste like chemical oxidation, ion exchange, precipitation, coagulation, or photo-chemical degradation can be done. High-temperature incineration can be used using special types of thermal equipment, fluidized-bed incinerators, multiple-hearth furnaces, rotary kilns, and liquid-injection incinerators. Biological treatment can be done too. As the facility has to manage large volumes of waste, they should transport it to a treatment center. A future hazardous waste management unit at the facility can effectively modify the plant.

The Resource Conservation and Recovery Act (RCRA) deals with the safe management of hazardous waste. However, hazardous waste from pesticide production facilities can contaminate groundwater and surface water resources, so risk management should be emphasized.

Hazardous material transport management

Rail transportation of hazardous materials is considered the safest method for moving large quantities of hazardous waste in the United States. The facility uses an industry-authorized method of transporting hazardous waste. However, the shipping of waste and the raw material in the cargo train along with passenger trains on the same rail lines can have potential hazards. Facility management can analyze the recent trend of accidents related to chemical facility transportation to minimize leaks, spills, and consequent damage to the surrounding environment due to hazardous materials released during transport in and out of the facility. Regular inspection of the rail cars and general improvement of inspection methods to reduce the possibility of accidental derailment will be beneficial. In addition, management should look for the research available to improve railroad transportation safety and implement it in the facility.

Conclusion

There are significant amount risks is associated with the mid-size city in the Southeast and only the major risk management recommendations are pointed out.

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