TerranearPMC Safety Share

Week of October 24, 2016 – Bhopal

It is hard to believe that one of the world's worst industrial disasters happened over thirty years ago. It was on December 3, 1984 in Bhopal, India: a city in the central Indian state of Madhya Pradesh. Because this incident occurred in 1984, it is very likely that a whole generation of Americans never heard of this tragedy. While it has been over 30 years since this event, its story needs to be told and retold. That is because the events that contributed to this tragedy could have been controlled and therefore, an unfortunate occurrence could have adverted. Understanding the "who, what, where, when, how and why's" of a disaster are important so that we may understand how to avoid similar tragedies in the future. To simply ignore devastation and leave it in the past – something that happens too often - is like waiting for the same incident to occur once again. As the philosopher, George Santayana, once warned, "Those who do not remember the past are condemned to repeat it."

In 1969, Union Carbide built a chemical production facility in Bhopal, India. The factory was designed to produce the pesticide carbaryl. As part of the manufacturing process, methyl isocyanate (MIC) was used. This material is extremely toxic and is a known inhalation and eye/skin hazard. Exposure symptoms includes severe skin damage, coughing, chest pain, dyspnea, asthma, irritation of the eyes, nose and throat. Occupational exposure limits are set at the airborne concentration of 0.02 parts per million (ppm) (ACGIH TLV). At higher levels of exposure (over 21 ppm), humans can succumb to pulmonary or lung edema, emphysema and hemorrhages and bronchial pneumonia; all which are potentially fatal. Although the odor of methyl isocyanate cannot be detected at 5 ppm by most people, it has properties to be a formidable tear gas agent. For instance, at a concentration of 2–4 ppm, a person's eyes become irritated, while at 21 ppm, test subjects could not tolerate its presence.

While this facility manufactured carbaryl with MIC, other processes became available that did not need MIC and thus reduce the risk of potential exposure. In addition, in the early 1980s, the demand for pesticides had fallen, but production continued, leading to a build-up of unused MIC.

Just prior to the day of the chemical leak, a number of safety devices, such as pressure relief valves and pipes were noted to be in poor condition while gas scrubbers and a boiler (which was supplying steam to clean pipes, were not functioning. While it is not exactly clear what happened next, water entered a tank that contained 42 tons of MIC. This caused a "runaway" exothermic reaction resulting in a substantial increased pressure and although the pressure sensors indicated this increase, employees thought the gauges were malfunctioning. By 11:30 p.m., workers in the MIC area were feeling the effects of minor exposure, and began to look for a leak. At 11:45 p.m., a leak was found which was reported to the MIC supervisor. The decision was made to address the problem after a 12:15 a.m. tea break, where afterwards, employees were instructed to continue looking for leaks. The leak was discussed by MIC area employees during the break.

At 12:50 a.m. as the concentration of gas in and around the plant became difficult to tolerate, an employee triggered the plant's alarm system. Activation of the system initiated two siren alarms: one that sounded inside the plant, and a second directed outward to the public and the city of Bhopal. However, the two siren systems had been decoupled from one another in 1982, so that it

was possible to leave the factory warning siren on while turning off the public one. Workers, meanwhile, evacuated the plant, travelling upwind.

A few minutes later, Bhopal's superintendent of police was informed by telephone, that residents of the neighborhood of Chola (about 2 km from the plant) were fleeing a gas leak. Calls to the plant by police gave assurances twice that "everything is OK." Meanwhile, the city's hospital was informed that the gas leak was suspected to be ammonia. A few minutes later, they were told the leak was phosgene. They were then told that it was "MIC", which hospital staff had never heard of and had no antidote.

Upon contact with the atmosphere, the released compound began to decompose into several highly toxic gases that formed a lethal cloud. Since these gases were denser than air, they swept across the city on the ground. Thousands of people and living things died almost immediately, as they were suffocated by the toxic cloud. At the same time, many died in accidents while trying to escape – the result of desperate and chaotic evacuation attempts to leave the city.

An estimated 10,000 people died in the first week after the toxic leak and at least 25,000 later died as a direct result of the disaster, which affected more than 600,000 people, 150,000 of whom had prior illnesses that were exacerbated from this incident. In addition, thousands of livestock and pets also perished and the whole environment around the location of the accident was seriously polluted by toxic substances and heavy metals.

This disaster did not just occur without any warnings. From 1976 to, right up until this incident, there were no less than 8 separate incidents that involved chemical releases, and/or worker exposures – some quite serious. Yet, appropriate corrective actions were never implemented. Numerous accident investigations have been conducted – some were performed by the internal organization and others by outside entities. What emerged from the Bhopal disaster was a recognition that a number of fundamental controls were missing. They include: 1) Lack of a strong safety culture (i.e. having a questioning attitude and poor behavior of management and employees to notice and report unusual observations), 2) non-existent management systems and regulations that are designed to have operation processes checked continuously (this includes emergency warning protocol), 3) proper safety mechanisms built into the plant design (ensuring pressure relief values and gauges work), and 4) eliminating hazards that are unnecessary to an operation or work step. This last point pertains to the fact that main cause of the disaster was unnecessary storage of large quantities of MIC.

As anyone who studies or investigates accidents can tell you, disasters and accidents are preventable. It is unfortunate that it usually takes a tragic event to get the attention of those who have the ability to correct high-risk situations. Zero Accident Philosophy is based on the premise that we can all work effectively and in a timely manner without compromising our safety and health.

It will never happen to me Captain EJ Smith (Captain of the Titanic – quoted in the press just before sailing)