Ethics Case Study: The Bhopal Tragedy

Course Number: ET-02-203

PDH: 3

Approved for: AK, AL, AR, FL, GA, IA, IL, IN, KS, KY, LA, MD, ME, MI, MN, MO, MS, MT, NC, ND, NE, NH, NJ, NM, NV, NY, OH, OK, OR, PA, SC, SD, TN, TX, UT, VA, VT, WI, WV, and WY

State Board Approvals

Florida Provider # 0009553 License #868
Indiana Continuing Education Provider #CE21800088
Maryland Approved Provider of Continuing Professional Competency
New Jersey Professional Competency Approval #24GP00025600
North Carolina Approved Sponsor #S-0695
NYSED Sponsor #274

Course Author: Mathew Holstrom

How Our Written Courses Work

This document is the course text. You may review this material at your leisure before or after you purchase the course.
After the course has been purchased, review the technical material and then complete the quiz at your convenience.
A Certificate of Completion is available once you pass the exam (70% or greater). If a passing grade is not obtained, you may take the quiz as many times as necessary until a passing grade is obtained).
If you have any questions or technical difficulties, please call (508) 298-4787 or email us at admin@PDH Pro.com.

Introduction

During the night of December 2nd and 3rd 1984, a leak of some 40 tons of methyl isocyanate (MIC) gas mixed with unknown other gasses from a chemical plant owned and operated by Union Carbide (India) Limited, a partly-owned subsidiary of the US-based Union Carbide Corporation, caused one of the highest-casualty industrial accidents of the 20th century. At least 2,000 people died immediately and another 200,000 to 300,000 suffered respiratory and other injuries of varying severity. Property damage consisted mainly of contamination to nearby areas by various chemical residues. The defoliation of trees immediately afterward is clearly attributable to the gas leak; contamination in the nearby settlements may have multiple sources, the contamination of the plant site resulted from many years of general production activity.

Industrial disasters and natural disasters do not occur under similar circumstances. A natural disaster is a single event over which no human being has control. But an industrial crisis is a complex system of interdependent events and involves multiple, conflicting stakeholders. This is an accurate description of what happened in the Bhopal tragedy. A series of human actions lead up to the final "triggering event" – the gas leak – that created the worst industrial disaster in history. This course seeks to present the technical actions and decisions that led up to this disaster, although a complete accounting of the events may never come to light because the survivors and their advocates, Union Carbide Corporation (UCC) and the Indian Government all have their own versions of what happened and doubtfully will ever change those views.

Need for Pesticides

In the 1970's, the crops in India were being destroyed by insects, increasing the hunger and poverty of millions of peasants dependent upon the yield of their crops for both income and personal sustenance. The government of India, seeking to increase the industrial capacity of the country, agreed to license the American company, UCC, to manufacture its insecticide Sevin in India. The UCC representative behind this deal, an experienced sales executive named Eduardo Munoz, calculated that the maximum amount of annual Sevin sales would be two thousand tons. However, the license was for five thousand tons and the Union Carbide management - who had no experience with the Indian population - insisted the plant be designed to produce this amount of insecticide. The way the company compensation schedule was

designed, they would be paid more with a bigger plant. Even the project's chief engineer supported this plan.

Construction of a Pesticide Plant in Bhopal

The insecticide Sevin, considered a safer replacement for DDT, was currently being manufactured at UCC's Institute plant near South Charleston, West Virginia. A team of engineers from this plant, familiar with the dangers of the highly-toxic chemicals that would be made during the production process, was assigned responsibility for the design and opening of the plant. Engineers from India worked with American engineers. Employees from India were sent to West Virginia to train at the Institute plant. *Safety First* was a motto of Union Carbide that was imparted to these trainees, mainly through a 400 page manual in English with detailed instructions for responding to emergencies. However, to save money, the final design, released in 1972, did not include all the same safety and security precautions featured at the Institute plant in West Virginia. While the plant at Bhopal was supposedly designed using the same process as the Institute plant, more recent evidence has indicated that the plant at Bhopal was actually using an "unproven technology" for MIC processing.

American engineers from South Charleston went to India to monitor the construction and start-up of the plant in Bhopal to be run by Union Carbide India Limited (UCIL). Union Carbide Corporation owned just over 50% of UCIL. The plant was seen as a great blessing by the people of the area, especially those living in extreme poverty in massive shantytowns, known locally as bustees, adjoining the acreage where the plant was later built. The plant paid the highest wages in the state of Madhya Pradesh. Experienced process engineer Warren Woomer was sent to Bhopal to run the new plant. He stressed safety, especially "the MIC manual with its forty pages of instructions" and stressed "only stock a minimum quantity of methyl isocyanate on site." This is the chemical known as MIC.

Early Accidents

The first fatalities from the plant were five cows living in a nearby bustee – cows are not only sacred in India but a health and economic asset. They were poisoned from water flowing from the plant. The community well was also contaminated. UCC reimbursed the villagers for the deaths of the cows. The report on the well water was too unfavorable to release, and the well was left alone.

The first human death at the plant occurred when Mohammed Ashraf, an experienced maintenance operator in the phosgene unit, was changing out a defective flange. The plant was not running so he assumed there was no chance of a leak and did not wear protective clothing. He was wrong. Some of the

chemical leaked onto his clothes. He jumped in the shower but removed his mask before the chemical had been all washed away. He died an agonizing death two days later, leaving a wife and two young sons. UCC defined this incident as a breach of the safety procedures that the deceased had been trained to follow but also stated that “it must never be allowed to happen again.” A third accident occurred when a joint in a MIC pipeline broke during maintenance, releasing the highly toxic gas. The plant was evacuated. The wind was not blowing towards the shacks in the bustees.

Cutting Costs

In May 1982, three American engineers from the Institute plant inspected the plant at Bhopal and found over 60 violations of safety and security regulations. The engineers at the Bhopal plant reviewed the report with great concern. Unfortunately their safety conscious leader, Warren Woomer, was being sent back to the US. To satisfy “the complete Indianization of all foreign companies” in India, an Indian with “an impressive academic and professional record", including engineering degrees from Cambridge University and MIT, Jagannathan Mukund was taking over the position of running the Bhopal plant. He was to report to a higher manager, D. N. Chakravarty, whose sole task was to cut costs. Chakravarty was a chemist but his experience was in battery manufacture, not in a plant full of highly-toxic chemicals. His cuts caused one of the chief Indian engineers at the plant, Kamal Pareek, to later reflect “we knew the plant was inevitably going to hell.” Maintenance schedules were lengthened. Stainless steel was replaced with carbon steel. Pareek mourned “My beautiful plant was losing its soul.” Ranjit Dutta, one of the original engineers to work on the Bhopal plant project, returned to Bhopal from where he was now working in America as a VP at UCC, and visited the plant. The site was in disarray. He tried to alert his superiors at UCC but they ignored him.

Five of the issues cited by the American engineers in this report and not remedied by UCIL eventually contributed to the fatal gas leak:

1. The potential for release of toxic materials in the phosgene/MIC unit and storage areas because of equipment failure, operating problems, or maintenance problems
2. A lack of fixed water-spray protection in several areas of the plant
3. The potential for contamination, excess pressure, or over-filling of the MIC storage tank
4. Deficiencies in safety valves and instrument-maintenance programs
5. Problems created by high personnel turnover at the plant, particularly in operations

A Plant in Decline

India's agricultural problems began to subside as government-supported agricultural improvements lead to a surplus of food that could be transported to all parts of the country through improved transportation and distribution systems. Cheaper pesticides were available from smaller manufacturers. While the plant had never produced more than 45% of its capacity, by 1984 UCIL's Bhopal facility was producing less than 1,000 tons, less than 20% of its capacity.

By the fall of 1983, after Chakravarty left, the factory was on a downhill slide. Production was on an as-needed basis. Then Mukund made the decision to “shut down the principal safety system... because the factory was no longer active, these systems were no longer needed. No accident could occur in a factory that was no longer operating.” Part of this shutdown included saving minimal costs by no longer refrigerating the MIC tanks -- the refrigerant was later pumped out of the system and used elsewhere in the plant. UCC’s safety standards were adamant that these tanks should be maintained at 0^{o}C.The flare tower was also taken offline as was the decontamination scrubber. This last of round of changes was too much for many of the engineers who had been with the plant since the beginning. By this time, half had already left. Finally one of the first and most dedicated, Kamal Pareek, left but not without first activating all refrigeration system to cool the three tanks of MIC down to 0^{o}C. The working environment of the Bhopal plant tolerated negligence and a lack of safety consciousness among workers and managers. Employee morale was low because the plant was losing money and being considered for divestment.

Warning Signs

During the five years preceding the Bhopal disaster, there were twenty-eight major MIC leaks at the Institute plant in West Virginia with one releasing 7 tons of a MIC/chloroform mixture a month before the Bhopal leak. In a document dated September 1984, Union Carbide was alerted to a series of defects at the Institute plant that put the employees’ safety at risk. The Bhopal plant was modeled after this plant. The document also described how a MIC leak could occur due to the presence of these defects. One factor was “miniscule impurities” produced by the refrigeration system that could trigger a reaction in the MIC tanks. Similar impurities could come from the flare tower. This information was not sent to Jagannathan Mukund, the director of the Bhopal plant.

The three underground MIC tanks were kept pressurized using nitrogen gas. This pressurization allowed the MIC to be pumped out of the tanks when needed for production and also kept out contaminants. On

October 21,1984, the pressure in MIC tank E610 dropped from about 1.25 kg/ sq cm to about 0.25 kg/cm. This tank contained about 42 tons of MIC that had been manufactured earlier that month. Because of the low pressure, MIC could not be pumped from this tank for production and had to be taken from tank E611 instead. Then on November 30th tank E611 also lost pressure due to a defective valve which was replaced. Tank E610 was not repaired. The lack of nitrogen pressure was later found to have allowed metal impurities into the tank which contributed significantly to the later disaster.

The Disaster

On the evening of December 2, 1984, Tank 610 was almost full with 42 tons of MIC, Tank 611 contained 20 tons and Tank 619 contained one ton, although safety standards specified it should be empty. Now, even though winter in Bhopal, the lowest expected ambient temperature was only 15°C. The tanks were not being cooled so the internal temperature was around 20°C. This amount of stored MIC was in violation of all UCC safety standards, as was storing it above 0°C.

While there appears to be no argument that water in the MIC tanks contributed to a runaway reaction that lead to the gas leak, there is not a consensus on how the water got into the tanks. Union Carbide maintains that the water was put into the tanks as an act of sabotage by a “disgruntled plant employee, apparently bent on spoiling a batch of methyl isocyanate.” However, Union Carbide has not named or pressed charges against this individual.

A second and apparently more widely reported version of what happened that night is that an operator accidentally pumped water into the MIC tank during a routine maintenance. This version begins when second shift operator Rahman Khan was told to flush out some pipes with water. These pipes had developed “a plastic substance called trimer” that was created when MIC reacted with water. Khan was still new and not familiar with this task but followed instructions left by another employee, only these instructions had one step missing – he needed to put in solid discs called slip blinds to block the flow into the MIC tanks. He began flushing the pipes, and noted this in the logbook before leaving at the end of his shift. According to reports, the maintenance supervisor was responsible for ensuring this maintenance procedure was properly performed, including the insertion of the slip blinds, but this position had been recently eliminated for both second and third shifts. A third theory to explain water in the MIC tank is that a well-intentioned but poorly informed and panicked employee poured water into the tank in an effort to cool down the MIC tank that was already exhibiting problems.

Purchase this course to see the remainder of the technical materials.