

Critical Infrastructure – Case Studies

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Case Study 1: A Lack of PPE

Module: Personal Safety and Emergency Response

Topic: Facilities Common Hazards and Personnel Protection

Personal Protective Equipment (PPE) is an important safety component to ensure that personnel are protected from the harmful effects of some of the equipment or materials with which they commonly work. So, when there is a lack of PPE in a situation where it is necessary, there can be disastrous results. In one such case, the death of an employee has resulted in numerous citations for the parent company that neglected to provide the PPE required to keep him and other workers safe.

In November, 2014, an employee with Ferro Magnetics (a battery charger manufacturer) was accidentally electrocuted while testing transformers in the company's high frequency testing department. The Occupational Safety and Health Administration (OSHA) performed an in-depth investigation into the accident and found that the company had not provided employees with adequate PPE—specifically, the necessary electrical insulation gloves—for conducting the tests with live leads to the transformers, which were operating at 1,200 volts. Without this required PPE, the technician unfortunately came in direct contact with the live wire and was electrocuted; though he was rushed to the hospital, he did not survive.

OSHA's investigation of Ferro Magnetics after the deadly accident resulted in a total of 15 violations, 14 serious and 1 willful (with the death of the technician being cited as a willful violation) that carried proposed citation penalties of more than \$106,000. The willful violation was quite damaging: it cited that the company willfully placed employees at risk by failing to provide and require employees to follow safe practice when working with live parts, failing to provide employees with the PPE necessary for the dangerous work being performed, and failing to install the necessary protective items (protective shields, protective barriers, and/or insulating materials) required to protect those employees working with energized equipment.

The serious violations claim that the company did not provide a safe, hazard-free workplace; did not do its due diligence of assessing the hazards of the workplace and evaluating the need for PPE; did not provide the necessary PPE for a variety of hazardous tasks (including proper eye and face protection, skin protection, and hand protection); did not establish proper protocols for energy control prior to performing maintenance tasks; did not provide proper emergency wash stations; did not provide proper training for employees; and many other violations that could have resulted in serious injury or death to an employee.

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Case Study 2: Failing to Plan Ahead

Module: Personal Safety and Emergency Response

Topic: Emergency Response Procedures

Failing to plan ahead for any emergency event at an MCO facility can have disastrous—and in many cases, even dangerous—consequences for the facility, its personnel, or any of the general public that relies on the services or products that the MCOs provide. Let's take a look at what could potentially happen when a facility fails to plan ahead.

A pharmaceutical facility has been located in the Philadelphia suburbs for over 30 years. At the time it was built, the location was classified as outside of a 100-year floodplain, deeming it nearly flood-proof. For this reason, though, they did not construct the facility with the most precise flood-related design in mind—the extent of plumbing intended for use in the case of a flood were floor drains and emergency sump pumps. Over the years, the eight one-story, stand-alone buildings and surrounding grounds have been upgraded, and it is now considered a state-of-the-art facility, including an environmental health and safety office and a highly trained facilities staff.

In recent years, strong summer storms with intense rainfall have increased, and have been resulting in ponding in the parking lot and on road surfaces. Then, last summer, a series of storms rolled through, with heavy rain almost daily over a two week period. After the first week, standing water formed in the parking lot and remained there for two days. By the beginning of the second week, the water in the parking lot wasn't draining at all—the catch basins were pushing water out instead of allowing water to drain. Low sitting cars were told not to park in the parking lots and employees wore boots or flip-flops to walk from building to building.

By the middle of the second week, the water had risen above the thresholds of the buildings, which were equipped with the floor drains and sump pumps. However, the floor drains were piped to the storm water system which was, unfortunately, also operating as the overflow drains for the parking lots that were now filled with water. The sump pumps that had been installed had been intended only to be used as a last resort, and hadn't been used or tested in several years; several were no longer operating and those that were only dumped water into the already flooded parking lots. Although the research lab benches were sufficiently elevated off the floor, the storage racks full of pharmaceutical products and other equipment used in research were all floor-mounted.

But this became the least of the facility's problems. The chillers for the air conditioning system located outside the building had been installed on 6-inch concrete pads, and were now sitting in 12 inches of water—causing them to automatically shut down. Temperature and humidity levels in the buildings rose, and the facilities personnel had no ability to control them. To make matters worse, the primary server room for the entire complex was not equipped with an independent system. The temperature rose to a point where the servers shut down and all the important company data for the past thirty years was lost—all because of a few week's worth of rain.

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Case Study 3: Disaster in Bhopal

Module: Personal Safety and Emergency Response

Topic: Emergency Response Procedures

As noted, spills and leaks can have damaging, harmful effects on both people and the environment. This was the incredibly unfortunate case following a serious toxic gas leak at the Union Carbide India Limited (UCIL) pesticide plant in Bhopal, India—commonly considered the worst industrial accident in history.

The UCIL plant was located in an area surrounded by the small shanty towns where thousands of people lived. The plant used many chemical substances in the production of its pesticides, including methyl isocyanate (MIC)—a highly toxic substance that is extremely hazardous to humans. On a night in early December, 1984, a malfunction in some pipes and valves allowed water to enter one of the MIC holding tanks, causing a chemical reaction and increased pressure in the tank. The emergency venting system engaged, releasing around 30 tons of a dangerous mix of MIC gas and other chemicals into the air. The gas cloud, buoyed by winds, made its way out of the plant and into the neighboring shanty towns.

While the cause of the leak is still a matter of debate—the Indian government says that a lack of routine pipe maintenance caused a backflow of water into one of the holding tanks, while Union Carbide Corporation (the plant's holding company at the time) contends that someone sabotaged the holding—its consequences are undeniable. More than 558,000 people have experienced injuries from the event, close to 4,000 of which are permanent disabilities. The official death toll, according to the Indian government, was close to 4,000 people (though others have estimated that closer to 8,000 died within the first two weeks of the accident and another 8,000 have died from related issues in the years that followed).

Additionally, facility records showed that there had been seven other chemical-related incidents at the plant in the eight years preceding the disaster, five of which were MIC or other chemical leaks that resulted in severe injuries to the workers involved. In one case, in 1982, 24 workers were exposed to a gas leak and were admitted to the hospital, because they hadn't been required to wear PPE to protect them from the toxic fumes. In most of these cases, local authorities were aware of the issues and had warned the company of these problems, but no corrective actions were ever taken. Evaluation of the facility after the disaster also pointed to a lax attitude towards safety precautions, including the lack of proper maintenance of critical equipment.

The long-term effects continue to this day, with many who live in the immediate vicinity suffering from neurological disabilities, blindness or other vision issues, skin and respiratory disorders, and birth defects. It's possible that these ongoing medical issues are linked to the environmental effects of the disaster, as the soil and ground water surrounding the plant have been confirmed as contaminated with the toxic substances released during the event.

Cleanup of the site continued for close to 15 years, but stopped in 1998 when the holding company at the time, Eveready Industries India Limited, terminated its lease and gave control of the site to the state government. Environmental tests in the years since have shown that the affected area continues to be contaminated. 20 years on, samples taken of the local drinking water have levels of contamination 500 times higher than the maximum amounts (according to the World Health Organization) and groundwater tests show that contamination can be found almost two miles from

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the facility. As recently as 2011, environmental scientists and activists have called for renewed efforts to finish cleanup of the site and address the ongoing environmental effects of the Bhopal disaster—more than 30 years after the initial event.