



DPC Enterprises Chlorine Release

Festus, Missouri August 14, 2002

On the morning of August 14, 2002, a hose used to transfer chlorine from a railroad tank car to the DPC Enterprises plant near Festus, Missouri, suddenly burst and began releasing thousands of pounds of highly toxic chlorine gas into the air, endangering hundreds of workers and residents in the vicinity of the plant.

Automatic and manual shutdown systems failed to work, and the release continued for about three hours. Emergency responders were finally able to stop the leak by crossing through a four-foot-deep yellowish-green fog of chlorine, climbing on top of the tank car, and closing several manual shutoff valves. By that time some 48,000 pounds of the gas had been released to the environment.



After three hours, responders were able to shut off the chlorine leak.

While the leak continued, fire department personnel notified residents of the Blue Fountain mobile home park and another neighboring area to evacuate. Authorities ordered hundreds of residents, office workers, occupants of an assisted-living facility and a learning center, and students in a local school to remain “sheltered in place” for four hours, staying inside for protection from the toxic gas. Police halted traffic on nearby Interstate 55 for nearly one and one-half hours to keep vehicles from driving into the dangerous cloud.

Although light westerly winds kept most of the chlorine away from residential areas, some of the gas likely drifted into the Blue Fountain mobile home park, the CSB said.

THE DANGERS OF CHLORINE

Approximately 12 million tons of chlorine are manufactured in the United States each year. When inhaled in high concentrations — 1,000 parts of chlorine per million parts of air (ppm) — chlorine gas is fatal after a few minutes. Breathing 430 ppm is fatal after 30 minutes; even concentrations as low as 10 parts per million are classified as IDLH, or “immediately dangerous to life or health,” according to federal guidelines. Chlorine also causes skin burns.

The accident caused 63 people from the surrounding community to seek medical evaluations for respiratory distress, with three admitted to the hospital for overnight observation. In addition, three workers received minor skin exposure to chlorine during cleanup operations after the event. The chlorine also caused trees and other vegetation around the facility and in the plume path to turn brown until the following spring.

HOSE RUPTURED SUDDENLY DURING WORK BREAK

The DPC Enterprises facility, which had 12 full-time employees in August 2002, repackages chlorine, transferring it from railroad tank cars into smaller containers for commercial, light-industrial, and municipal customers. About 9 a.m. on the morning of the accident, six workers — four packaging operators, an operations manager, and a truck driver — put the repackaging operation on standby and went on break. Twenty minutes later, three men who were smoking outside the building heard a loud popping sound and saw chlorine escaping from a tank car. They rushed to evacuate the area.

Three men inside a break room heard a chlorine leak detection alarm and saw chlorine entering the building through an open door and quickly rushed outside. The operations manager pushed the emergency chlorine transfer shutoff button on his way out, but it failed to close the valves on the rail car. An automatic emergency shutdown system, triggered by chlorine sensors, also failed to close the valves.

LACK OF TESTING LED TO HOSE MIX-UP

CSB investigators determined that the ruptured hose was not constructed of the correct materials for chlorine service. This type of chlorine transfer hose should have an inner Teflon lining reinforced by an exterior metal braiding made of Hastelloy C-276, an alloy which resists the highly corrosive effects of moist chlorine. But the hose that DPC workers installed actually had a stainless steel braiding, which is easily corroded and weakened by chlorine. The hose lasted only 59 days before bursting under pressure.

Hoses made with Hastelloy or stainless steel braiding look exactly alike. DPC bought Hastelloy chlorine transfer hoses from a fabrication company, Branham Corporation. Branham purchased large reels of Hastelloy hose from a manufacturer, fabricated the hose to specified lengths,

installed end-fittings, and then labeled the finished hoses with paper tags for shipment. Shipping documents and the paper tag attached to the hose that was delivered to DPC erroneously indicated that the braiding material was Hastelloy. Investigators concluded it was likely that the mix-up had occurred at the hose fabrication company.



Hastelloy (left) and stainless steel hoses appear identical.

Investigators noted that a nondestructive testing method known as X-ray fluorescence can quickly distinguish between stainless steel and Hastelloy braiding. However, this technique was not in use at either DPC or Branham Corporation prior to the accident. Such testing, known as “positive materials identification,” is necessary where different materials look alike and where a mix-up can lead to a highly hazardous event. The CSB concluded that quality assurance systems were inadequate at both DPC and Branham, setting the stage for the accident.

IMPROPERLY TESTED SHUTOFF VALVES FAILED

The DPC Festus facility had chlorine monitors, safety alarms, and automatic shutoff valves in place that were supposed to stop the flow of chlorine in case of accidental discharge. But the CSB found that four of the five safety shutoff valves failed to close completely when the emergency occurred, due to corrosion and lack of maintenance. Although workers believed they were effectively testing the emergency shutoff system by activating it once each day, they were not required to verify that the valves were fully closed when the system was triggered.

DELAYS IN RESPONSE MAGNIFIED RELEASE

As DPC employees rushed to evacuate, they notified emergency authorities about the release; but neither the company nor local agencies had an effective system for notifying neighbors. There were no community sirens and no system for making telephone alert calls — sometimes called “reverse 911” calls — to area homes. Instead firefighters, who arrived about 10 minutes after the leak began, had to go door-to-door through neighborhoods with bullhorns ordering residents to evacuate.

The company’s own emergency training and drills were also inadequate, the CSB said. In addition, chlorine-protective gear was stored in the chlorine packaging building too close to the tank car unloading station. Once the

chlorine leak began, the gear became engulfed and inaccessible, leaving workers no alternative but to flee the plant.

The CSB found that emergency responders from Jefferson County, Missouri, were also unprepared for the accident. It took about an hour and a half to assemble all of the county’s volunteer hazardous materials (HAZMAT) team members. The HAZMAT team determined that chlorine concentrations at the scene were greater than 1,000 parts per million (ppm) — life-threatening to personnel without proper respiratory equipment. It then took another 45 minutes to plan entry to the site and don protective suits. By the time team members reached the rail car and were able to shut off the leak, a massive amount of chlorine had been released.

RECOMMENDATIONS

On December 4, 2002, the CSB issued a safety advisory calling on all chlorine users to verify that their transfer hoses are constructed of the correct materials. On May 1, 2003, the CSB approved its final investigation report and safety recommendations.

To DPC Enterprises

The CSB recommended that DPC develop programs to ensure that chlorine hoses are made of the correct materials, emergency shutdown systems are properly tested and maintained, and chlorine-related corrosion is addressed through preventive maintenance and inspection. DPC should also revise its emergency response plan, improve its community notification procedures, and conduct regular emergency drills in coordination with local authorities.

To DX Distribution Group

The CSB recommended that DPC’s corporate owner, DX Distribution, conduct periodic audits of the Festus facility’s safety systems and revise its corporate safety training programs for chlorine operations.

To Branham Corporation

The hose fabricator was urged to implement a system to ensure that the chlorine transfer hoses it supplies are readily identifiable and meet required specifications.

To the Jefferson County Emergency Management Agency (EMA)

The CSB recommended that the county’s emergency authorities work with DPC on an immediate-alert community notification system.

To the Chlorine Institute

The CSB recommended that the Chlorine Institute, a trade association, develop an industry-wide system to allow positive identification of chlorine transfer hoses.

Published May 2004

NOTICE:

The CSB is an independent federal agency charged with investigating industrial chemical accidents and hazards. The CSB determines the root causes of accidents and issues safety recommendations to industry, labor, and other government agencies. CSB Investigation Digests are not intended to substitute for the official, Board-approved reports, which can be obtained from the agency’s web site, www.csb.gov. The web site also has complete, up-to-date information on the implementation status of all CSB safety recommendations. Comments or suggestions, please write to info@csb.gov.