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Case Study: Ontario, California (August, 2004)

In the following example, insufficient training on bypassing the safeguards on a medical materials sterilization chamber led to an explosion.

Impact: Explosion; 4 injuries; community evacuated; facility damaged.

Sterilization chamber after explosion

CSB Report Cover

Summary:

Early on the date of the accident, the control system indicated an Ethylene Oxide (EO) system failure in a sterilization chamber. Operators decided to abort the cycle, using a button on the control room console. After the abort cycle, chamber contents were moved to an aeration room. The chamber was left open for maintenance.

After running checks and finding no problems with the EO addition system, the maintenance technicians conducted the initial evacuation of the chamber to the acid scrubber and then asked for permission to skip the wash steps and proceed to the end of the cycle. This required a bypass of a password-protected interlock that was intended to ensure that the chamber was purged of EO through the series of wash steps prior to the chamber door being opened. However, operators and the maintenance supervisor incorrectly believed the washes were done for product quality only. Since there was no product in the chamber, they believed the washes were not necessary for process safety and permission to use the bypass was granted.

Minutes after the bypass, the chamber door was cracked opened. This automatically activated the ventilation duct, designed to sweep residual EO from the sterilization chamber to an oxidizer. Because the gas washes were omitted, about 50 pounds of EO entered the ventilation system, igniting as it reached the oxidizer. Area monitors activated as EO leaked from the chamber, but time was insufficient to trip the oxidizer or evacuate before the vapor cloud ignited. The flame travelled back through the chamber to ignite the remaining EO, causing a massive explosion that sent both chamber doors flying outward. Injuries to four individuals in the control room overlooking the sterilization chamber area occurred as a result of overpressure shattering the windows.

Photograph of building damage from chamber door

CSB Report Figure 12

Instrumentation and Controls Gaps:

- Operator training conducted after 1997 did not caution that initial purge only removed 60% of EO; the initial training in 1997 did not clearly reinforce the necessity of gas washes for an empty chamber

- Maintenance leader was assumed to have requisite knowledge to authorize safety interlock bypasses for maintenance purposes, without additional supervision or training
- Wash step logic bypassed to expedite restart
- No gas concentration monitoring or other compensating measures existed to manage risk during a bypass operation
- Windows in control room overlooking the sterilization chamber area were not blast resistant

Key Automation Learning Points:

All personnel involved in the lifecycle of instrumented safeguards should be trained on the design intent of each task expected from them. This training should address predicted abnormal operating modes as well as routine operation. In this case study, both operators and the maintenance supervisor given the responsibility of authorizing the use of safeguard bypasses by maintenance technicians should have been trained that the washes were always required to purge the highly explosive material from the chamber, whether the chamber was empty of product or not. Periodic competency assessments should be used to ensure that training was effective and the skills have been retained over time. Written operator procedures should also clearly describe the function of the safety systems and the hazards that they are designed to prevent. Bypass procedures should include the compensating measures that must be used to manage risk when a particular safety function is to be bypassed. Finally, recognized and generally accepted good engineering practices should always be applied to occupied building design, even if instrumented safeguards have been installed to manage process risk.

Source:

CSB. 2006. *Investigation report - Investigation report - Sterigenics.* Report 2004-11-I-CA. Washington, D.C.: U.S. Chemical Safety Board.