Case 126. 36-year-old male production operator was killed as a result of a pressure vessel explosion.

A 36-year-old male production operator was killed as a result of a pressure vessel explosion. The unfired pressure vessel involved in the incident purchased in 1988 and was controlled by a process logic control (PLC) that was located in an adjacent control room. The pressure vessel had a wall "body" thickness of 3/16 of an inch and the top "head" of the vessel was 3/8 inches thick. The vessel nameplate indicated an operating pressure of 250 psig at a test temperature of 445 degrees. The vessel per the drawings was designed to a 443 psig hydrostatic test before failure to occur. The control room was constructed of eight-inch cinderblock walls with safety glass so the vessel room could be observed while in the control room.

The explosion occurred during the processing of wheat. The wheat was preheated at another location in the building. The preheated wheat is transported to the pressure vessel and the PLC initiates the dumping of 70 pounds of preheated wheat into the pressure vessel. The preheated wheat entered the pressure vessel through the top hat ducting and the top valve on the vessel. After the wheat entered the vessel, the top valve closed and the PLC opened the steam valves. The steam raised the pressure in the pressure vessel to an operating pressure ranging between 180-250 psig depending upon the moisture content of the wheat and other factors. The process involved having the steam enter the vessel for approximately 25 seconds to reach the desired psig (220 psig) and operating temperature (180 degrees F) and continued to cycle on and off for approximately 125 seconds. The steam valve then closed and the bottom valve of the pressure vessel opened to expel the wheat through an orifice to a catch basin below. The wheat is then further processed in other areas of the facility. After the wheat is expelled, the PLC returns the pressure vessel cycle to a start position and the process is repeated. There is an eight-second window of time between when the bottom valves are opened and the wheat released and the top valve opens to accept a new load. The pressure vessel did not have a pressure relief valve on the vessel or between the inlet steam valve and the vessel. There are two alarms for the pressure vessel dealing with production needs and when the top hat is opening.

On the day of the incident, there was a brief power outage. A power outage causes the PLC to go through a reboot procedure that took about seven to nine seconds. The reboot procedure instructed the pressure vessel to return to a start position regardless of load status in the vessel. After a reboot, if a load was in the vessel when the vessel began its next cycle a two-tone alarm would sound, indicating that when the top valve would open and prior to receiving a new load of wheat, the wheat in the pressure vessel would be expelled through the top valve/top hat.

The two-tone alarm had been sounding for several minutes before the pressure vessel exploded. The decedent and his coworker were waiting for operating instructions from the PLC in the control room. The pressure vessel was located four feet from the control room and when it exploded, there was enough momentum to break free of the valve mountings and lines and break through the control room's 3-foot high 8-inch thick web

lined interior cinderblock wall. The decedent was standing in the vessel's explosion path and was struck by the vessel and other projectiles created by the explosion.

Further research conducted by the decedent's employer found that the wheat being processed when the incident occurred when left under pressure of 220 psig and normal operating temperature of 180 to 200 degrees F begins to break down and release its own byproduct which can create additional pressures that can increase the pressure in the pressure vessel.

MIOSHA General Industry Safety and Health Division issued the following Serious citations to the company.

SERIOUS:

ACT 154 PA OF 1974, SEC. 11(a).
Furnish to each employee employment and a place of employment, which is free from recognized hazards that are causing or are likely to cause death or serious physical harm to the employee.

The employer failed to ensure adequate pressure relief devices were installed on their unfired pressure steam vessels, know as puffer guns, exposing employees to over pressurization and explosion of the puffer guns.

MIOSHA gave the following abatement recommendation: Among other methods, one feasible and acceptable abatement method to correct this hazard is to install safety relief devices on vessels, down stream of the inlet steam valve as described in ASME Boiler and Steam Vessel Code General requirements UG-125 a and b in version 1980.

SERIOUS:

GENERAL PROVISIONS, PART 1, RULE 11(a).
Provide training to each newly assigned employee regarding the operating procedures and hazards of the job.

Inadequate training on the use, hazards, and proper operation of the unfired pressure vessels known as wheat puffer guns.