MNM Fatal 2012-12

- Falling Material Accident
- August 17, 2012 (Florida)
- Victim Recovered September 4, 2012
- Cement Operation
- Cement Equipment Operator
- 58 years old
- 19 years of experience

Overview

The victim was killed when the silo roof he was working on collapsed. The cement roof slab, beams, and the grout in the beam pockets failed causing the roof and the equipment on the roof to fall into the 3/4 full silo. Rescuers responded and the victim was recovered from the silo on September 4, 2013.

He or was on top of Silo 12 to measure the level of material in the silo. Miners had to manually check the silo levels several times each shift because the radio transmitter level indicator and the high level indicators for the silo were not functional.

The accident occurred due to management's failure to correct defects on the silo where the victim was working. The roof decking on Silo 12 was inadequately attached to the roof beams, causing the beams to become unstable and buckle; the grout under the beam ends was too thick and some of the grout in the beam pockets had cracked and delaminated; and the shear stirrups were placed too far below the beam ends to prevent the grout in the beam pockets from failing in shear. Also, in 2004 a roof beam was cut when a penetration was made into the roof to install an automatic level detecting device. This cut significantly reduced the load carrying capacity of the beam. These defects led to the collapse of the silo roof slab that was supporting the victim. In addition, adjacent Silo 11 had experienced a partial roof failure in 2011 that caused the roof to bulge and caused significant cracking in the reinforced concrete. Management did not adequately investigate the causes and conditions surrounding the Silo11 partial roof failure and therefore did not identify similar conditions existing under the roof of Silo 12.

Overview

Management also allowed the silos to operate with defective aeration systems and the presence of a large rathole (partly caused by those defective systems). When the cement would bridge over the rathole and then collapse during discharge, this would create significant suction loading and detrimental vibrations on the roof slab, beams, grout in the beam pockets, and welds. In addition, other equipment including high level indicators and an automatic level detection device were inoperable, making manual measurement necessary and the over pressure events more likely. The over pressurization in the silo resulted in upward pressures on the silo roof slab and its support system (puddle welds and beams), and damage to those components.

When combined, these equipment-related defects and structural deficiencies contributed to the collapse of the roof slab.

Root Cause

Root Cause: Management failed to correct defects on Silo 12 where the victim was working. Specifically, the operator failed to determine the cause of a partial roof failure the previous year on an adjacent silo. Silos 10, 11, and 12 had not been built to specifications; maintained appropriately; and the operator added additional strain on the silo by allowing the silo to operate with an internal rathole and by subjecting the silo to overpressures during its life of operation. In addition, a modification had been made to Silo #12 that significantly weakened the roof.

Corrective Action: Silos 10, 11 and 12 at this mine have been under a Section 103(k) order since August 18, 2012, and have been the subject of an ongoing investigation. The operator must take the actions necessary to repair these three silos, and with the knowledge learned from this investigation prevent future unsafe conditions in the remaining silos at the mine. MSHA will require the operator to take appropriate actions to address the root cause of this accident to ensure that miners can safely work on or near Silos 10, 11, and 12.

Best Practices

- Routinely inspect the entire silo including walls, top, hopper(s), feeders, conveying equipment, liner, roof vents, etc. Look for structural damage, exposed rebar, stress cracks, corrosion, concrete spalling/cracking, signs of overfilling, top lifts, dust spills from seams during loading, damage to climbing devices, etc. The structure should be inspected by a professional engineer knowledgeable in silo design and construction.
- Ensure a competent person conducts examinations to identify hazards.
- If damage is discovered, prohibit use of and access on the silo and in the surrounding area until repairs are complete and/or a registered professional engineer has declared it structurally safe to use.
- Modifications or equipment additions to a silo should be under the direction of a professional engineer.
- Ensure process controls and dust collector baghouses are in working order to prevent overpressure, overfilling, or excessive vacuum. Dust leaving a silo may indicate structural damage or equipment malfunction.
- Ensure aeration systems and other means of enhancing hopper flow are in working order so asymmetric flow patterns do not develop within the silo and damage the walls, hopper, and roof.
- Provide silo level probes/weight measuring technology for /equipment to monitor silo material filling and discharge in the silo and keep it in working order.