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SUBJECT: Re-Issue of P09-15 - Potential Safety Hazard Related to Explosion of Pumps

Scope
This Program Information Bulletin (PIB) applies to all Mine Safety and Health Administration (MSHA) enforcement personnel, mine operators, independent contractors, and equipment manufacturers.

Purpose
The purpose of this bulletin is to alert enforcement personnel, mine operators, independent contractors, and equipment manufacturers to potential safety hazards related to catastrophic failure (explosion) of pumps and/or associated components.

Catastrophic failure of pumping systems can occur due to an overpressure condition created within the pump when fluid flow through the pump is lost, resulting in the overheating of any trapped fluid within the pump case. Loss of fluid flow can occur due to a blockage in the discharge and/or inlet piping. It can also occur due to a malfunctioning or inadvertently closed valve.

Catastrophic failure can also occur due to a sudden surge of fluid ("fluid hammer") through the pump or into downstream components after a delay in acquiring fluid, especially when the pump is turning at or near rated speed.

Information
Catastrophic failure of pumping systems can be reduced by detecting one or more loss-of-flow conditions. Loss-of-flow conditions can be detected by 1) using direct fluid flow measuring equipment, 2) measuring the pump motor current draw (amperage) to detect loss of pump load, and/or 3) measuring the pump temperature to detect overheating of the fluid. Monitoring pumps for loss of flow will help detect dangerous conditions resulting from malfunctioning equipment, loss of fluid pickup or plugged or restricted discharge and/or inlet piping.

Flow sensing devices can be installed which automatically shut down the pump if flow stops for any critical period of time. These devices can be simple paddle switches in a clean fluid such as well water, or they may be more sophisticated devices that do not come in contact with the fluid, such as magnetic flow meters for aggressive fluids such as slurries.

Motor current sensing devices, which alert and automatically shut down the pump whenever the motor current draw drops below the expected operating range for any critical period of time can be installed in the system. Pump motor current typically drops when the feed is reduced and the pump ceases to pump material.

Thermal sensing devices can be installed to measure the temperature of the liquid in the pump volute. A warning temperature and an automatic pump shut down temperature can be programmed into certain types of controllers. The American Society of Mechanical Engineers (ASME) requires two temperature sensors, one primary and one backup, when used as a safety device in this manner. Some types (styles) of these devices can be attached to the pump without drilling or tapping. Some programmable controllers allow for multiple set points such as alarm and shut down, so that remedial action could be performed to alleviate a problem before tripping the device. Mine operators should contact their suppliers or, the pump manufacturers for further assistance in identifying and implementing appropriate pump safety controls.

Background
A plant operator received fatal injuries when a clean coal filter drain pump exploded due to restricted material flow which caused heat and pressure buildup within the pump. The access cover plate from the pump was blown off the pump striking the operator. The victim was standing approximately 8 feet away at the on/off switch when the pump cover struck him. The pump's discharge line had become clogged, but the pump continued to operate. The coal slurry in the pump volute became overheated, resulting in heat and pressure building to the point the cover plate was blown off.

The second fatality occurred when a fuel handler was fatally injured at a cement operation when he attempted to bleed air from a liquid waste-fuel system. An in-line grinder ruptured, and the escaping waste fuel ignited, engulfing him in flames. This

accident could have been prevented if a flow device had sensed that the pumps were not producing any flow. Also, the catastrophic failure of the grinder occurred due to an overpressure condition.

A miner was seriously injured when a centrifugal pump that was moving sand slurry exploded. Shrapnel from the explosion struck and seriously injured a miner 30 feet away. An investigation revealed that a plugged inlet and a restricted discharge was responsible for the explosion. The cause of the plugged inlet and restricted recharge is unknown. However, it is believed the pump may have been previously overheated and developed cracks due to backflow of cool fluid. These conditions could lead to the pump being unable to withstand normal operating pressures, or a plug in the discharge was dislodged by the explosion.

In a non-injury accident, which could have resulted in a mine disaster, a pump in an underground mine exploded because material flow became restricted which caused the pump to overheat. The explosion of the overheated pump destroyed two permanent stoppings more than 150 feet from the explosion, and other stoppings that were out of the direct line of forces were also destroyed. Miners felt the blast more than 800 feet away. Approximately 175 pounds of the pump material were not found.

Authority
The Federal Mine Safety and Health Act of 1977, Section 107(a).

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