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EMPLOYEE SAFETY AT OPEN PIT MINES IN PERU, TANZANIA, THE DOMINICAN REPUBLIC AND THE USA

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1. INTRODUCTION

The worldwide mining industry has been impacted by significant lightning-caused production delays and safety issues. Some examples are:

- 1.1 Mine-wide mobile radio communications fail following a lightning strike to a central radio tower. Surge protection is absent. (Canada)
- 1.2 Five maintenance workers are injured when lightning strikes a stationary vehicle. The lightning early warning system is low cost and old technology. (Peru)
- 1.3 A central computer system is damaged by a lightning strike. Important geological data is lost. Grounding methods are in violation of codes and standards. (Ghana)
- 1.4 More than \$US one million is spent on some 350 unconventional-design lightning rods. The product is not approved by USA or international lightning protection codes and standards. Safety to all buildings is compromised. (Peru)
- 1.5 Miners are killed when lightning explodes methane gas inside a subsurface mine. A comprehensive approach to lightning safety is absent. (Many hundreds of deaths in coal mines in China, Russia, & USA.)
- 1.6 Four of eight gas turbine generators suffer lightning-induced failures. Production losses at the mine are \$600,000/day. The power shortage lasts three months. Earthing is poor. (Papua New Guinea)
- 1.7 Lightning causes failure of a primary water pumping system. Underground flooding closes the mine for 45 days. Surge protection was absent. (South Africa)
- 1.8 A smelter operation is “frozen” after lightning hits a substation. 164 pots have to be dug out by hand. Production is shut down for seven weeks. Earthing is poor. (USA)
- 1.9 A large haul truck is struck by lightning with consequential tire explosion. Grenade-like fragments kill two workers. (Mexico)
- 1.10 A mine superintendent standing outside during a thunderstorm is killed by lightning. He ignored weather warnings. (Australia).
- 1.11 A radio operator inside a building is killed by lightning. Grounding is poor. (Indonesia)
- 1.12 Two workers are killed, with seven injured in two separate incidents. There is no employee lightning safety training. (Laos)
- 1.13 Two exploration crew members struck by lightning are airlifted to hospital. The lightning detector fails to warn of threat in time for evasive action. (Haiti)

These and other examples support a conclusion that programs to adopt risk management criteria to lightning hazards will provide substantial economic benefits. This paper discusses the application of a lightning safety planning process which can be applied to most mining operations.

2. LIGHTNING SAFETY AND HAZARD MITIGATION FOR PEOPLE.

No place outside is safe from lightning and absolute personal lightning safety is impossible. Consider a “First Strike – No Prior Warning” event” as an example. Large-scale above ground mining activities may extend for many kilometers in area and may involve many thousands of employees. Some people may be remote from the principle production areas, such as exploration teams. Contemporary risk management principles suggest the adoption of a plan of integrated lightning safety activities.

- 2.1 Detection
- 2.2 Notification
- 2.3 Safe Shelter
- 2.4 Re-Evaluate Threat
- 2.5 Resume Activities
- 2.6 Policies/Procedures
- 2.7 Education & Training

3. CODE COMPLIANCE AND LIABILITY ISSUES. NFPA-780 Annex M.4 contains Lightning Safety for Outdoor Worker recommendations.

- 3.1 Detectors are to be monitored continuously.
- 3.2 If thunder is heard, suspend operations.
- 3.3 Notify all affected personnel via radio, texting, voice, sirens, etc.
- 3.4 Three stage Alert Program:
 - Yellow at 30-60 km (20-40 miles) radius.
 - Orange at 16-30 km (10-20 miles) radius.
 - Red at 0-16 km (0-10 miles) radius. Basis is two times 5 miles – US Air Force.
- 3.4 Re-Assess threat. Sound All Clear after one half hour of no thunder or lightning.

4. SAFE SHELTERS. What is safe?

5. CONCLUSION.

Lightning has its own agenda and may cause damage despite application of best efforts. In order to mitigate the hazard, systematic attention to details of grounding, bonding, shielding, air terminals, surge protection devices, detection & notification, safe shelters, personnel education, maintenance, and employment of risk management principles is recommended.

Case studies in Africa, Australia, the Dominican Republic, South America the USA and elsewhere have provided conclusive evidence that adoption of lightning safety measures have increased personnel safety at large scale mining operations.

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