NSW Resources
Resources Regulator

Investigation report

Loader fire at Cadia Mine results in serious injury to a worker

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1. Investigation into loader fire at Cadia Mine

Incident date: 25 October 2021

Event: Loader fire at an underground metal mine

Location: Cadia Valley Operations

1.1. Overview

A worker was operating a LH621 Sandvik loader in the underground workings of the mine on 25 October 2021, when a fire was observed near the front left (**position one**) tyre. The worker activated the fire suppression system, exited the cabin and observed flames around the rear of the loader. The worker suffered serious burns while running past the loader's engine bay to escape the fire.

Figure 1: Fire damage to the loader's position one tyre

Figure 2: The rear left side of the loader and the operator's cabin with fire damage (inset)

1.2. The investigation

An examination of the fire scene identified, among other things, an area of scorched ground under the loader. Samples of material from the area were obtained for testing which revealed it contained 5.3% cellulose nitrate (also known as nitrocellulose) and 2% ammonium nitrate.

Despite a thorough investigation, the source of the material, and how it came to be in the vicinity of the loader fire, could not be established.

However, on 31 March 2023, the Regulator received information that lead to further investigation enquiries that established that about 448 kg of an explosive mix used in an AutoStem brand product was disposed of by workers in the vicinity of the loader fire around 18 September 2021 (4 weeks before the fire). The disposal process involved cutting open the AutoStem cartridges, emptying the product onto the ground, and the product then being immersed in water on the roadway using a water cannon.

Figure 3: Sample of the material found at the fire scene

The investigation established that AutoStem was stored at the mine for up to 3 years, and the mine's written procedure did not specifically address disposing of explosives in the manner undertaken before the incident. AutoStem products were disposed of at the mine in small quantities during blasting activities. A mine worker involved in the pre-incident disposal had disposed of AutoStem through immersion in water, albeit in much smaller quantities of about 10 kg.

AutoStem is a class 1.4S explosive material that contains, among other things, ammonium nitrate and cellulose nitrate and can be used to break rock and concrete. It has a flash point of >180 degrees Celsius, an auto ignition temperature of >150 degree Celsius and is a flammable solid. Significantly, ammonium nitrate is soluble in water, but cellulose nitrate is not. Accordingly, exposing the explosive material from the AutoStem cartridge to water alone would not have completely dissolved it.

Figure 4: Example of an AutoStem cartridge disposed of at the fire scene

1.3. Potential ignition sources

Ammonium nitrate will not ordinarily combust when exposed to heat without the presence of another fuel source. However, cellulous nitrate can combust when exposed to heat greater than 150 degrees Celsius. Plant, including loaders, may generate heat or cause friction events with temperatures greater than 150 degrees Celsius.

While the AutoStem composition may have varied as a result of it being watered down, the investigation determined that any degradation of the cellulous nitrate was likely to have been negligible or minimal and it was likely to have remained flammable.

1.4. AutoStem disposal methods

Section 11.2.2.4 of Australian Standard 2187.2-2006 Explosives-Storage, Transportation and Use provides small quantities of water soluble explosives may be disposed of using water. Noting AutoStem is only partially soluble, in that the cellulous nitrate component is not water soluble. The AutoStem safety data sheet provided it was only partially soluble and recommended cartridges be transported to a suitably qualified and equipped authority or supplier for disposal.

1.5. The cause of the loader fire

It was likely the material on the ground at the fire scene, either wet (paste), dry or a mixture, included traces of cellulous nitrate, which came into contact with a heat source, or friction from the loader and ignited.

2. Recommendations

Mine operators must establish and implement explosive control plans, standards, procedures, guides and training material that:

1. give practical effect to Australian Standard (AS) 2187, Explosives Storage, Transportation and Use and the Australian Explosives Code – refer Explosive Regulation 2013 cl. 65 (a) and 97 (1) (e)
2. incorporate:
    a. methods of disposal for explosives that are appropriate for the type and condition of the explosives – refer Explosive Regulation 2013 cl. 98 (b)
    b. processes for the destruction of explosives by the holder of a blasting explosives user licence (**BEUL**), or by an individual acting under the immediate supervision of the holder of a BEUL, unless the explosives have been returned to the supplier – refer Explosive Regulation 2013 cl. 97 (1) (a) and 97 (2)
    c. processes for risk assessment that include the disposal of explosives with appropriate controls identified and safe work procedures implemented to manage risks – refer Work Health and Safety (Mines and Petroleum Sites) Regulation 2022 cl.27

   d. manufacturers guidelines and relevant safety data sheets considered in risks assessments and safe work procedures governing the disposal of explosives.

3. ensure workers responsible for managing and using explosives are provided appropriate information, instruction and training in explosive control plans, standards, procedures, guides and training material governing the safe disposal of explosives. See Work Health and Safety Regulation 2017 cl.39 and Work Health and Safety (Mines and Petroleum Sites) Regulation 2022 cl. 107.