

POSITION PAPER

Storage of large quantities (greater than 250kg NEQ) of fireworks in NSW

Background

As a result of the fireworks explosions at Wallerawang NSW in December 2007 and a similar incident at Mount Carmel in Western Australia in 2002, WorkCover NSW released a discussion paper outlining proposed reforms for fireworks storage and handling in NSW.

The aim of the discussion paper was to consult industry and jurisdictional counterparts about proposed measures to ensure safe storage of fireworks throughout NSW, prevent recurrence of a similar incident and reduce the risk to the community from such storage. The paper outlined some of the problems associated with the use of converted freight containers for storage of fireworks and proposed (among other things) some alternatives for storage and mounding. The discussion paper was put to the Pyrotechnics Industry Association of Australia (PIAA) in March 2008 and the Australian Forum of Explosives Regulators (AFER) in May 2008.

This position paper has been developed after consideration of the feedback on the discussion paper and gives detail about the reforms to be implemented in NSW. It is intended to provide the fireworks industry with improved options for storage of large quantities of fireworks and timeframes for implementing such options.

Existing requirements for storage of fireworks

Legislative requirements

Storage of fireworks in NSW required magazines to be set up in compliance with the NSW Explosives Act and the NSW Explosives Regulation, by mandating compliance with Australian Standard AS 2187.1-1998 (the Standard). However, the Standard is ten years old and its review is overdue, particularly with respect to lessons learnt from past incidents at Enschede in the Netherlands, at Mount Carmel in Western Australia and now at Wallerawang in NSW.

General construction

Recent incidents indicate that compliance with the Standard on the construction of magazines, the magazine-to-magazine separation distances and the option to not have mounding, will not sufficiently mitigate the consequences of a major explosion.

Magazine construction

One contributing factor may be the highly confining nature of using freight containers. The degree of confinement may cause fireworks of a lower hazard division to explode en masse, thus making the Standard's safety distances for those lower hazard divisions inadequate.

Process building construction

Process buildings of light construction with line-of-sight to explosives magazines have been shown to be prone to damage, and may cause injury to personnel in the event of an initiation in a magazine during normal business times.

Mounding

Recent incidents have shown that fireworks classified as Hazard Division 1.3 and stored in unmounded magazines (in compliance with the Standard), under certain circumstances, may behave like fireworks of Hazard Division 1.1. For example, burning fireworks confined in a closed steel freight container may burn to detonation. Moreover, if the containers are not mounded, there is inadequate protection to other containers similarly set up.

The preliminary information from recent incidents suggests that they were initially caused by a container detonating. The fact that there was no mounding between containers (set up for Hazard Division 1.3 storage) contributed to multiple detonations, deflagration and burning of a number of containers, due to penetration by metal shrapnel and burning fireworks debris from the initial detonation.

Separation distances

The Standard allows for converted freight containers to be used for storage, providing they are located at the prescribed separation distances for the quantities and the nominated hazard division of fireworks. For unmounded magazines, these separation distances appear to be insufficient to prevent or mitigate the knock-on effects of an explosion.

Classification

Another factor is the difficulty in classifying fireworks for storage. The classification of fireworks has to be determined either by testing in accordance with the UN Manual of Tests and Criteria, or by using the default fireworks classification table in the UN Model Regulations. The process is based on the effect obtained when the fireworks, packaged for transport, are subjected to certain stimuli that they might be subjected to during that transport. Since this classification process is for transport applications, it cannot be directly applied to storage, particularly when the effect of confined storage (such as in freight containers) is not considered by the standard test criteria.

New requirements for storage of fireworks

To mitigate the likelihood and likely consequence (both within and external to a site) of an explosion, storage in strict compliance with the Standard is considered inadequate for quantities of fireworks equivalent to a net explosive quantity (NEQ) greater than 250kg. Hence, WorkCover is imposing additional requirements and rules to those outlined in the Standard. These new requirements and rules are stated below.

General construction requirements

For sites where fireworks are to be stored or manufactured, the construction (including mounding) of magazines and process buildings must mitigate the consequences of an event should an initiation occur.

Magazine construction requirements

Light frangible construction (LFC)

Such a magazine must be constructed from very light gauge steel or aluminium (or other material that would easily disintegrate or give way to an explosive deflagration or detonation), thus preventing confinement and rapid build-up of pressure. The minimum thickness of the material is that which is legally permitted by the Building Code of Australia (BCA) for a specified building size. The frame required for the building needs to also be of minimal robustness legally permitted by the BCA. If the structure allows build-up of heat during the hotter periods of the year, the structure must incorporate a sunshade or other insulation measures to reduce heat build-up. Doors for the magazine must be adequate to permit access to the contents and must be lockable. The use of a roller door, for example, is permitted. The intention is to have a door that is no stronger than the walls of the building. The magazine need not be lined, except for protection from heat (sun), if the construction material is non-sparking and anti-static.

An alternative LFC construction to the above is to construct mounding for the magazine as per figure B1 (b) of appendix B of the Standard and use the inner vertical wall of the mound as the wall of the magazine. The roof must be of light construction. The contents of this type of magazine must be located at least 0.5 metres away from the walls. Again, ingress of heat from the elements needs to be adequately mitigated.

Heavy construction, concrete (HCC)

These magazines must be constructed of reinforced concrete with a roof that can be raised or a sacrificial wall that is able to be pushed over or disintegrate to relieve rising pressure, should the contents initiate.

Heavy construction, steel (HCS)

These magazines may be constructed as per the construction requirements of the Standard, with additional restrictions with respect to mounding and separation distances – as outlined in the new rules contained in this position paper.

Process building construction requirements

Because fireworks are more sensitive to heat, sparks, friction, electrostatic discharge and impact than blasting explosives, process buildings (for manufacturing fireworks) must be constructed in such a way to minimise the hazard to or from the magazines on a site. The matrices later in this discussion paper specify which process building construction types are permitted for each type of magazine, mounding and fireworks hazard division.

Light frangible construction (PLF)

This involves light frangible construction materials that offer almost no protection from falling debris from an explosion in another building – in such an event the PLF building may end up substantially damaged and persons inside may be at risk of injury. For example, an aluminium shed is considered to be a PLF.

Heavy construction (PH)

A heavy construction involves a substantially-constructed building that will offer protection from falling debris from an explosion in another building – in such an event the PH building may end up with some relatively minor damage and persons inside that building will most likely be protected from injury. For example, a concrete-walled building with a concrete roof is considered to be a PH.

Mounding construction requirements

There is some evidence that mounds built to the requirements of figure B1 (a) of appendix B of the Standard do not adequately prevent shrapnel from travelling long horizontal distances. Therefore, construction of mounding must comply with the requirements of figure B1 (b) of appendix B of the Standard. This is the preferred mound design because it is more effective in providing a barrier to high velocity debris that is propelled in a trajectory that would allow it to travel long horizontal distances on-site and beyond.

The mound height specified in (c) of appendix B of the Standard is considered inadequate in providing shielding to protected works from shrapnel. For all magazine types, the height of the mound must comply with the rule in the Federal Government storage requirements for explosives. This requires that the mounding be high enough so that a straight line drawn down at 10 degrees below horizontal from the top of the mound will be higher than the top of any stack of explosives, no matter where the explosives are located in the building.

Separation distance requirements

Because there is evidence of debris travelling distances further than the separation distances stipulated by the Standard, WorkCover is mandating separation distance requirements for licence holders – in addition to the requirements of the Standard – depending on how a site is set up for storage. These requirements are stated in this paper under the heading of New rules in addition to the Standard.

Classification requirements

A graded system of safety will not work effectively if the classification of fireworks is not correct. The requirements above are based on the fireworks being classified either in accordance with the UN Manual of Tests and Criteria or by the default classification table in the UN Model Regulations.

WorkCover may review the classification based on an assessment of all information available. WorkCover may deem fireworks to be of a higher risk classification if an applicant cannot provide more information to support the initial classification.

Classification is a complex process, and the current internationally recognised system for transport cannot be applied directly to storage. Although many countries have some systems in place, Australia has no agreed system of classification of explosives for storage at present. There is currently a review of the authorisation of fireworks in NSW. This review intends to more specifically and accurately classify fireworks when they are submitted for authorisation.

New rules in addition to the Standard

In addition to any requirements stipulated in the Standard, the following new requirements apply to licence holders authorised under the NSW Explosives Act and take precedence over any contrary requirement of the Standard:

Storage

1. Magazines must not be filled to more than two thirds of the volume of available space, and must be spread in a manner so that there is no concentration of fireworks in any one area.
2. Process buildings must use minimal quantities (less than or equal to a nominal 50kg NEQ) of explosives-in-process in a building.

Construction

3. For storage of more than 250kg NEQ of completed fireworks articles, part assemblies and pyrotechnic compositions, the magazine construction requirements of LFC, HCC or HCS apply.

Separation distances

4. For LFC magazines with mounding, separation distances of the Standard apply.
5. For LFC magazines without mounding, separation distances of the Standard apply – with the added requirement that Protected Works Class B distances apply to the site boundary.
6. For HCC magazines with mounding, separation distances of the Standard apply.
7. For HCC magazines without mounding, separation distances of the Standard apply – with the added requirement that Protected Works Class B distances apply to the site boundary.
8. For HCS magazines with mounding, Hazard Division 1.3 fireworks are to be always considered as Hazard Division 1.1, and the Hazard Division 1.1 separation distances of the Standard apply – with the added requirement that Vulnerable Facilities distances of Hazard Division 1.1 apply to residences.
9. For HCS magazines without mounding, Hazard Division 1.3 fireworks are to be always considered as Hazard Division 1.1, and the Hazard Division 1.1 separation distances of the Standard apply with the added requirement that twice the Vulnerable Facilities distances of Hazard Division 1.1 apply to residences.

Mounding

10. For an NEQ greater than 1500kg of fireworks of Hazard Division 1.1, mounding – to figure B1(b) of the Standard – is compulsory for all magazine constructions, irrespective of whether the Standard allows mounding to be optional.
11. PLF process buildings can only be installed at a site if magazines on that site are mounded, at least in the line-of-sight from the process buildings.
12. Where process buildings on a site are of heavy construction, mounding is optional, but only if the appropriate separation distances of the Standard exist between the process buildings and the magazines.

Classification

13. The classification of fireworks, which must be accepted by WorkCover through the authorisation process, must be properly determined as per the UN system for classification.
14. If necessary, WorkCover may nominate any type of firework as being of Hazard Division 1.1 (or any other hazard division), or a hazard division different to that specified under the UN system for classification.
15. Aerial shells 4" and above are considered to be of Hazard Division 1.1, when applying separation distances of the Standard for storage.
16. Pyrotechnic components and pyrotechnic compositions (such as stars and flash powder) that go into a firework article are not classified for transport because they are manufactured, stored and used on-site. These components and compositions must, until further study, be considered as Hazard Division 1.1 for storage, unless there is evidence that indicates otherwise.
17. Fireworks where technical information and/or test data is not available must be initially considered to be Hazard Division 1.1, irrespective of their nominal classification.
18. Fireworks for disposal where technical information is not available and/or their origin is not known must be considered to be Hazard Division 1.1, irrespective of their nominal classification.

Matrices

The rules on page 4 have been summarised in the following matrices:

Legend

HCC – Heavy construction magazine, concrete, with a roof able to be raised or a sacrificial wall able to be pushed over to relieve rapidly rising pressure.

HCS – Heavy construction magazine, steel, with no significant pressure relief.

LFC – Light frangible construction magazine, protected from sunlight heat.

Mounded – Mounding to comply with figure B1 (b) in the Standard.

PH – Heavy construction process building, to appropriately accommodate the processes and associated hazards within.

PLF – Light frangible construction process building, to appropriately accommodate the processes and associated hazards within.

For Hazard Division 1.1 (and 1.2)

Magazine type	Mounded?	Permitted process building	Separation distance requirements
LFC	Yes	PLF or PH	As per the Standard.
LFC	No	PH	As per the Standard, except that the Protected Works Class B distance also applies to the site boundary.
HCC	Yes	PLF or PH	As per the Standard.
HCC	No	PH	As per the Standard, except that the Protected Works Class B distance also applies to the site boundary.
HCS	Yes	PH	As per the Standard, except that the Vulnerable Facilities distance also applies to off-site residences.
HCS	No	PH	As per the Standard, except that twice the Vulnerable Facilities distance applies to off-site residences.

For Hazard Division 1.3

Magazine type	Mounded?	Permitted process building	Separation distance requirements
LFC	Yes	PLF or PH	As per the Standard.
LFC	No	PH	As per the Standard, except that the Protected Works Class B distance also applies to the site boundary.
HCC	Yes	PLF or PH	As per the Standard.
HCC	No	PH	As per the Standard, except that the Protected Works Class B distance also applies to the site boundary.
HCS	Yes	PH	As per the Standard for Hazard Division 1.1, except that the Vulnerable Facilities distance also applies to off-site residences.
HCS	No	PH	As per the Standard for Hazard Division 1.1, except that twice the Vulnerable Facilities distance applies to off-site residences.

For Hazard Division 1.4

Magazine type	Mounded?	Permitted process building	Separation distance requirements
LFC	Yes	PLF or PH	As per the Standard.
LFC	No	PH	As per the Standard, except that the Protected Works Class B distance for Hazard Division 1.3 applies to residences.
HCC	Yes	PLF or PH	As per the Standard.
HCC	No	PH	As per the Standard.
HCS	Yes	PLF or PH	As per the Standard.
HCS	No	PH	As per the Standard, except that the Protected Works Class B distance for Hazard Division 1.1 applies to residences.

Other considerations

Storage of class 1.1G up to 250kg NEQ

While this paper does not deal with these quantities, the requirements of the Standard apply. WorkCover will provide additional advice and assistance in relation to the storage of quantities up to 50kg NEQ.

Lightning protection

Magazines and process buildings need to be protected from lightning strikes. In this regard, the requirements of the Standard apply. The Standard refers to AS 1768, which was reviewed in 2007.

Security

Security requirements for some types of construction will need to be enhanced. This may involve such measures as substantial fencing, intruder alarms, security mesh etc depending on each individual situation.

Timeframes for implementing the new requirements

WorkCover allowed a 12 month timeframe from 1 September 2008 to allow the industry time to upgrade to the new requirements set out in this paper.

Certain existing facilities posing a higher risk due to the nature of the site and the quantity of fireworks stored were required to take immediate corrective actions.

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