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Technical reference guide

Stockpiles and reclaim tunnels

Safety requirements (MDG28)

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Amendment schedule		
Date	Version	Amendment
January 2023	Consultation Draft	Redraft of MDG28 *Safety requirements for coal stockpiles and reclaim tunnels* – For consultation. The guide has been developed to apply to all mining operations.
April 2023	Version 1	In response to stakeholder feedback included a section on recovery of broken-down equipment

Table of Contents

1. Introduction

This technical reference guide (TRG) replaces MDG28 Safety requirements for coal stockpiles and reclaim tunnels.

Surface stockpile and reclaim tunnels are important features of NSW mines. They also carry inherent risks, as there is potential for multiple fatalities if they fail. This technical reference guide focusses on the use of dozers on stockpiles and recovery systems in reclaim tunnels. It was developed to assist mine operators to identify and control risks when using this equipment and reflects acceptable industry practice.

Users of this guide should rely on their own advice, skills and experience in applying risk and safety management systems at individual workplaces.

The technical advice in this guide in is intended to be applied in conjunction with appropriate risk assessment techniques and described Australian Standards. This will ensure safe operating practices for stockpiles and reclaim tunnels.

1.1. Scope and application

This technical reference guide applies to all mines in NSW. It covers the design, construction, installation and safe use of stockpiles and product recovery systems in reclaim tunnels. Where necessary, this guide makes specific references to coal mines.

The guide applies to all stockpiles and product recovery systems in reclaim tunnels with the following plant and equipment:

- stockpile dozers in use on material stockpile and recovery areas
- reclaim tunnels with a physical connection to the material stockpile and recovery area.

This guide also applies to anyone who has a duty of care in relation to stockpiles and reclaim tunnels in NSW mines.

Mine operators may refer to this guide when developing and implementing relevant hazard management plans. However, this guideline does not identify all hazards that may arise from stockpiles and reclaim tunnels throughout their life cycle.

It is important to be aware that each operation is different and will require tailored safety measures. There are several factors that influence the design and implementation of safety measures for dealing with the hazards associated with reclaim tunnels and stockpiles. They include processing capacity, material characteristics and relevant operational requirements.

Equipment, systems, and the environment at each site will also differ. It is the individual mine operator’s responsibility to determine the hazards and risks that exist at the site and to develop and implement a site-specific hazard management plan.

1.2. Interaction with the safety management system

Where a site contains stockpiles, reclaim areas, or reclaim tunnels, the mine operator should develop and implement a plan to provide for the safe system design, operation, and maintenance. This plan forms part of the mine safety management system (SMS).

Development and implementation of the plan should ensure the mine operator provides:

- controls for managing risks that include safe work systems
- monitoring and verifying the effectiveness of the controls
- fit-for-purpose equipment
- trained and competent workers
- adequate supervision.

The plan should describe the design parameters of the systems. The plan should also include a statement that design parameters should not be exceeded or changed without a change-management process, an engineering study, and a hazard identification and risk review process.

Systems, procedures, plans and risk control measures are key elements of a mine's SMS. A mine operator may choose to manage hazards associated with stockpiles and reclaim tunnels within a relevant principal hazard management plan (PHMP). Alternatively, they could develop sub-plans or additional control plans. Some mines use stockpile management plans (SMPs) specifically developed to manage all activities associated with stockpiles and reclaim tunnels.

The SMS ties all the elements together into an integrated system to effectively manage the risks to the health and safety of all workers. A properly integrated system ensures there are no gaps and that all the elements work in a coordinated way.

2. Complying with the legislative requirements

A summary of the requirements in the Work Health and Safety (Mines and Petroleum Sites) Regulation 2022 relating to stockpiles and reclaim tunnels are set out in Table 1 below. It does not detail every requirement that a mine operator must meet in managing the risks to health and safety of managing stockpiles and reclaim tunnels.

Table 1: Summary of requirements in the Regulation regarding stockpiles and reclaim tunnels

Topic and section	Summary of requirements relating to stockpiles and reclaim tunnels
Reclaim tunnel Dictionary	A reclaim tunnel is defined as 'a tunnel in or under a coal stockpile used for removing coal from the stockpile'.
Inspection plan Section 88(2)(c)(ii)	A mine operator of a coal mine must ensure that when preparing the inspection plan for the mine, the areas where dumps or stockpiles are being used are included as part of the inspection plan.
Ventilation and belt conveyor components to be fire resistant anti-static (FRAS) Section 90(1)(b)	Conveyor belting and conveyor accessories used at an underground coal mine or in a reclaim tunnel at a coal mine are to be FRAS.
Ground or strata failure Principal Hazard Management Plans (PHMP) Schedule 1, Part 1, section (1)(m)	The design, layout, operation, construction, and maintenance of stockpiles must be considered in developing the control measures to manage the risks of ground or strata failure.
Mechanical engineering control plan Schedule 2, section 2(4)(c)	When developing a mechanical engineering control plan and control measures, Australian Standard AS 4606-2012, *Grade S fire-resistant and anti-static requirements for conveyor belting and conveyor accessories* must be considered in respect of belt conveyors at an underground mine or in a reclaim tunnel.

3. Stockpiles

Stockpiles are used extensively in surface and underground mining operations in the coal, metals, and extractives sectors. While the fundamental hazards associated with the management of stockpiles are similar across the industry, there are some hazards specific to coal.

This guide describes stockpile hazards in detail. They have been identified through consultation with mine operators and a review of accidents, incidents, and hazard management plans. This guide does not purport to identify all hazards existing at stockpile facilities. Mine operators should identify hazards and risks of harm to workers specific to their own sites.

There have been several dangerous incidents at stockpiles in Australia and overseas. Appendix A to this guide includes several case examples. Stockpile dozers falling or being inadvertently driven into draw-down holes are the most frequent serious coal stockpile incidents. Such incidents present serious safety consequences to the dozer operator. This type of incident commands special attention in the risk management process.

3.1. Hazards

Mine operators should design fixed infrastructure associated with the stockpile for the life of the facility. The structural design should be based upon the maximum expected future stockpile loading. There is a potential for catastrophic failure of plant or structures where this hasn't occurred. Mine operators should provide replacement plant and structures as necessary and consider the frequency of structural integrity reviews.

Mine operators should conduct a risk assessment. Its outcomes should form the basis of a review into the structural integrity of the stockpile and associated infrastructure. The scope and frequency of reviews should be guided by consideration or the age, size, condition, factors of safety (FoS).

Competent structural engineers should carry out periodic inspections of infrastructure where its failure may affect the health and safety of workers. When a new structure is commissioned, the designer should describe the critical structural elements, specific inspection requirements, and general structural integrity inspection requirements and frequencies.

Inspections may also be initiated in response to accidents and environmental events (e.g., adverse weather events).

Further information is available in the NSW Code of practice: Mechanical engineering control plan.

3.1.1. Change in operational use and design

Stockpile systems are designed for specific storage capacities and reclaim rates, and have equipment designed to achieve those capacities and rates.

Changes in the design parameters of the stockpile create potential risks to workers, equipment, and the environment. For example, changes to stockpile or reclaim capacity, or a change in the way the system is operated. When stockpiles are changed beyond their design limits, mine operators should conduct a change management process incorporating a review of the hazards and risk control methods.

3.1.2. Stockpile compaction and stability

Bulk material placed by tipping, discharge from overhead conveyors and trippers, and dozing can create stockpile instability. Placement areas are not designed as engineered compacted fill, and the size, shape, and degree of compaction constantly changes.

Tipper discharge areas and the sides of a stockpile must be properly compacted and correctly graded. The method of placing material, the force of placement, and the properties of materials are relevant factors in ensuring that this occurs. Gradients will vary depending upon the method, force of placement, and material properties. Draw-down points on the stockpile are also affected by changes in the free flow of material.

Properties affecting the free flow of material include:

- relative density
- moisture content (affected by weather, feed quality and process water)
- particle size and distribution
- segregation
- variations in feed quality (typically caused by ore being extracted from different areas of the mine or different areas of coal seams)
- placement rill angle
- drawn-down rill angle
- chemicals such as flocculants and magnetite
- the passage of time, particularly where the stockpile is exposed to the elements
- temperature – particularly freezing and thawing.

Placement angle of repose, and rill angles of draw on the edges of the material and adjacent to draw-down points can vary. Material can also be unstable. Sudden and unexpected slumping of the sides of the draw point can occur.

Inadequate compaction, unsuitable gradients for the equipment being used, and inadequate width can make access ramps to and within the material stockpile area hazardous.

Weather conditions and the operation of equipment can influence the compaction and stability of the pad.

Water can accumulate in hollows within a stockpile base. This can result in fluidisation of the stockpile, causing the stockpile to collapse and flow like a fluid.

Oxidation of the stockpiled material may weaken an area's ability to withstand loads applied by stockpile equipment.

Draw-down areas vary in shape and size and can be affected by water, variation in material properties and compaction by stockpile equipment such as dozers.

3.1.3. Draw points

The draw-down point's size, shape and degree of stability will vary depending upon the factors detailed in section 3.1.2 above.

Stockpile dozers may fall or to be inadvertently driven into a draw-down hole. Several serious incidents have occurred in Australia and overseas. Major contributing factors to such accidents include:

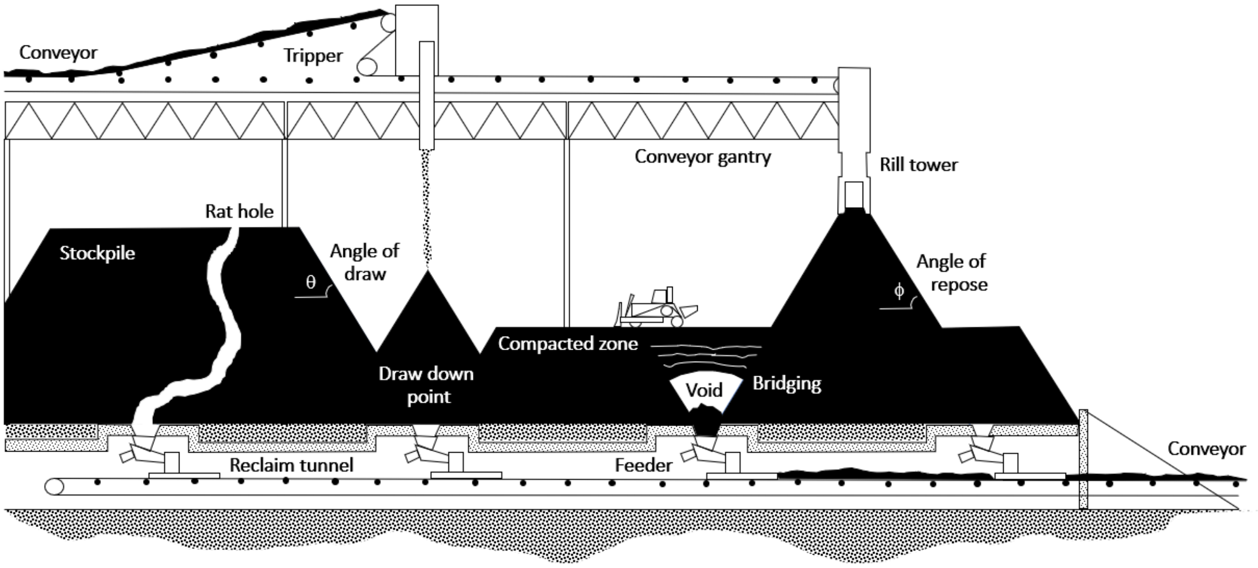
- the dozer operator not knowing where the draw point is (and either drives into the hole or drives too close to the hole, causing the dozer to slide in)
- related to the above factor, there are no surface structures or other navigational aids to help the dozer operator identify where the draw point is
- the dozer operator driving over the top of a bridged hole that collapses.

Bridging and rat-holing create voids that may not be identifiable from the surface. The bridging and rat- holes can collapse under the weight of stockpile equipment. This can result in the equipment falling into the void and potentially being engulfed by stockpile material.

Draw points could be adjacent to or beneath stockpiling placement structures. They can potentially be difficult for a mobile plant operator to see, particularly at night or where visibility is poor.

Draw points that are clear of any stockpiling conveyors or other structures and not identifiable from surface features are particularly hazardous. If such draw points bridge, there is no way of locating the feeder. It then becomes more difficult to avoid with a stockpile dozer.

Figure 1: Diagram of a coal stockpile and recovery facility showing bridging and rat-holing



Where a stockpile base and surface are not graded to allow water run-off and prevent the formation of central reservoirs, water may accumulate in a partially extracted stockpile. This can happen when a stockpile base and surface are not graded to allow water run-off and prevent the formation of central reservoirs. Water collection sites can sometimes only be discharged through the draw point. See section 4.1.7 Flooding for further detail.

Draw-down holes left in an open condition, can be hazardous to dozer operators.

Figure 2: A stockpile dozer has fallen backwards when a bridged draw point suddenly collapsed

Parking up stockpile dozers and other plant adjacent to the draw point (within a high-risk zone) is hazardous. The plant or vehicle's parking position is particularly important. For example, the hazard is greater if the position is of least stable alignment to, and potentially within, the area of influence of a draw point.

Non-operational draw-down feeders or valves can start operation without warning. This can cause a significant change in the surface area of the stockpile and the formation of a draw-down hole or void. This presents a risk to mobile plant and workers in the area.

Indicator lights or pre-start alarms indicating the start-up of a draw-down feeder or valve must be designed with backup redundancy or fault indication. They can be potentially hazardous otherwise. For example, if 'no indication' indicates a safe condition, but an indicator fails to activate, a hazard could be concealed. In this instance an indicator failure could mislead the dozer operator into believing conditions are safe to enter a hazardous area.

Figure 3: The dozer operator has driven into the draw point

3.1.4. Dozer engulfment

The blade and the material in front of it impair the dozer operator's ability to see the edge of the draw-down hole when pushing coal.

When the stockpile dozer has a full blade of material, the volume of material may fill the draw-down hole and reduce the risk. If there is little or no material in front of the blade, the risk of the dozer falling into the draw-down void increases.

When a dozer falls into a draw-down void, its cab may become entirely engulfed, depending on its dimensions and the stockpile height. This risk is greatest when draw-down hole depth is greater than the distance from the dozer blade to the cab. The size of the draw-down hole is at its largest when the stockpile height is near maximum. This is when operation of the draw-down feeder causes the void to develop to its maximum depth. The draw point can bridge through compaction of the stockpile material above the feeder and create a void. The bridge is at risk of collapse when the dozer passes over the draw point.

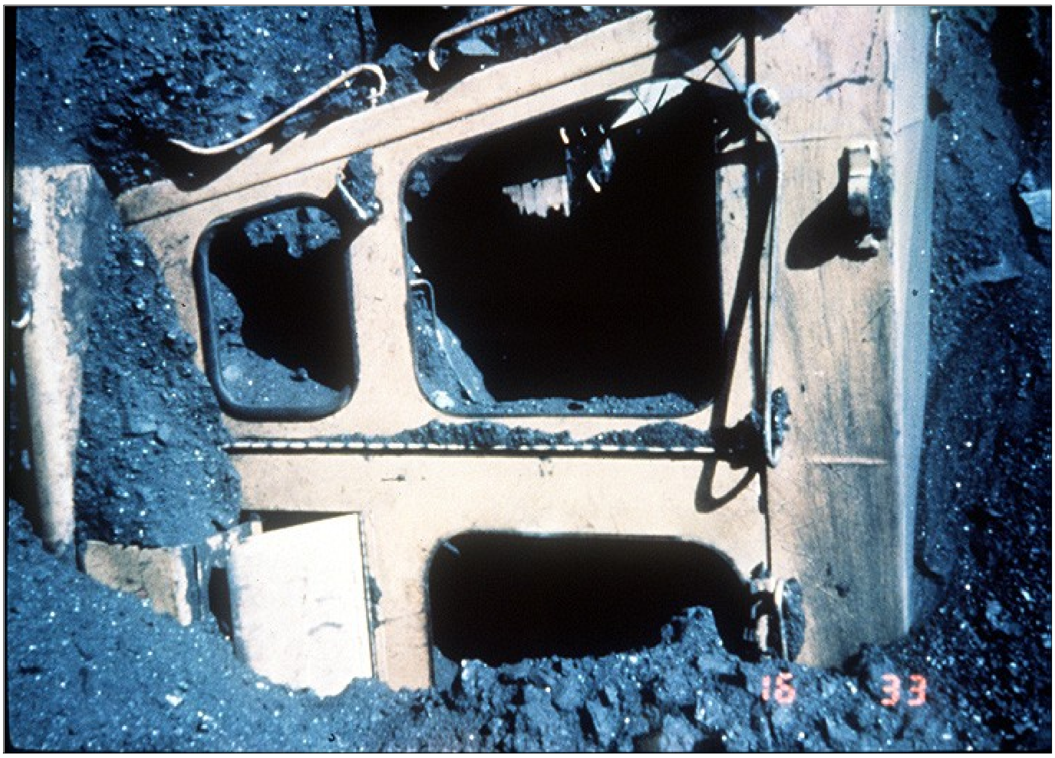
The angle of draw can be steep and the edge potentially unstable. If the stockpile dozer descends into the draw-down hole, material can collapse from the sides, burying the dozer cab. If the feeder continues to operate, the dozer is likely to be drawn further down into the hole.

If a stockpile dozer goes into a draw-down hole, it could go unnoticed by other system operators. The feeder could continue to operate, increasing the depth of the hole and compromising the safe recovery of the dozer operator.

Figure 4: The stockpile dozer that has fallen backwards into a draw point following the collapse of bridging. Note the thickness of the bridged material

If the windows of the stockpile dozer cab are not designed to withstand the burial forces applied, material can flow into the dozer operator's cab, placing the dozer operator at risk of engulfment, suffocation, and death.

Figure 5: Windows in the dozer operator's cabin of this stockpile dozer have collapsed and the cab filled with coal after the dozer fell into the draw point



For coal stockpiles there is a potential for coal to ignite if in contact with heated surfaces of the dozer.

Factors that influence the risk to an operator of an engulfed dozer include:

- the time taken for other plant operators to notice the incident and respond
- fire and the resulting smoke and gases in the cab and the effects of radiated heat
- collapse of the dozer windows caused by pressure of surrounding material and pouring in of stockpiled material
- the depth and stability of the hole, and the impact of these factors on recovery time
- whether recovery personnel have safe access to the accident site.

3.1.5. Unsafe bench heights

Material may be deposited by skyline conveyor trippers, front-end loaders, dozers, and trucks. The method of depositing material on the stockpile area impacts the stockpile height, rill angles, and the degree of compaction.

Material stockpiled by skyline conveyor trippers and similar can be at a significant height above the base level of the stockpile area. This can lead to circumstances where dozers are operating alongside stockpile material that is well above the height of the equipment. This may expose the dozer to a risk of sudden collapse of stockpile material onto the dozers.

3.1.6. Interaction with material emplacement structures

Dozers that are used near stockpile structures could strike and damage them, leading to catastrophic failure. These structures include rill towers, trestle legs, and gantry bridge sections.

Skyline support structures are most at risk. For example, trestle legs that are designed for the support of the stackout conveyor gantry system (and not for interaction with mobile plant). Where there is a risk that mobile plant could collide with fixed infrastructure, mine operator should implement controls to protect the structure. Mine operators should follow the hierarchy of controls, and not rely on procedural controls.

In determining necessary controls, mine operators should assess the probability of impact and the likely harm caused to mobile plant, fixed infrastructure, and workers.

3.1.7. Provisions for stockpile access

Occasionally, stockpile dozers need to travel from the top of the stockpile area to ground level. This may be for servicing or changing dozer operators. This becomes dangerous as the height of the stockpile increases and dozers must operate on unconsolidated side slopes. Doing this safely requires properly constructed ramps on the stockpile.

If the designed stockpile area or footprint of the stockpile area is exceeded, sufficient space to construct serviceable and safe ramps could be unavailable.

Exceeding the footprint area can also result in blocked perimeter access roads, reclaim tunnel entries, and stockpile drainage systems. It can also damage services such as fire-fighting mains and stockpile sprays.

3.1.8. Impaired visibility

Conditions that can affect the ability of dozer operators to see high-risk zones, no-go zones, and potentially hazardous areas (such as overhead conveyor structures, draw points, and stockpile edges), include:

- night-time operation
- dusty conditions
- rising or setting sun in front of the dozer operator

- heavy rain
- material stockpiled beyond designed limits
- dirty, scratched, or pitted windscreen
- fog and mist
- the impact of the size of the dozer blade blocking the operator's angle of vision.

Note: A coal blade on a dozer is larger than a rock blade.

3.1.9. Dozer operator competence and awareness

The scope of a dozer operator's competence training influences the level of risk to their health and safety. For example, where the operator's training is limited to conventional dozer operations. In these situations, the operator may lack experienced in working on stockpiles, especially those associated with reclaim systems.

Competency-based training courses are available for stockpile dozer operators, such as RIIMPO305F Conduct coal stockpile dozer operations. This course covers stockpile dozer operations in the coal mining industry. It also includes planning and preparing for activities, operating the dozer, undertaking stockpile operations and tasks, and maintenance activities.

The course covers all tracked dozers and those tasks and performance criteria that are within the legal and technical limitations of rubber wheeled dozers.

Mine operators should not rely on courses alone to provide competent stockpile dozer operators. Mine operators should provide additional training and familiarisation on site-specific controls and conditions. Mine operators should provide dozer operators with supervised practise on stockpiles in varying weather conditions, lighting, and stockpile volume, until deemed competent.

The recovery of material from some stockpiles may require large stockpile dozers to push material into reclaim points to supplement material recovered from a loading bin and live storage areas.

Even experienced and competent dozer operators risk losing control of their machines into a draw point if they are unfamiliar with the stockpile condition and planned operational procedures. The risk is increased if dozer operators do not communicate with dozer operators on the previous shift. Dozer operators should review the site procedures (valve and feeder operations) and check that valves and feeders are operating correctly at the start of and periodically during the shift.

3.1.10. Dozer operators working alone and unobserved

Dozer operators work alone and are often in locations where they are not in view of control room operators. It could therefore be some time before control room operators discover an issue. For example, if the equipment they are operating becomes defective, involved in an incident, or they suffer an injury. When remedial action or treatment is not immediately available, dozer operators are placed at risk.

The risk is increased where there is no ability for the dozer operator to:

- stop and start the reclaim gates, feeders, and conveyors
- stop stacker systems feeding the stockpile
- activate the site emergency alarm
- stop the dozer if the dozer operator becomes disabled in a draw-down incident.

Access to the stockpile can be hazardous if not managed effectively.

3.1.11. Mobile plant types and interaction

A variety of plant are used on stockpile sites, including:

- stockpile dozers (wheeled and tracked)

- excavators
- scrapers
- cranes/elevated work platforms
- emergency vehicles
- service vehicles
- front end loaders
- trucks.

Site hazard management plans should account for the use of such plant listed above. Hazard management plans should consider risks such as those arising from variations in the weight and dimensions of equipment. Other risks include stability on the stockpile, ground pressures, dozer operator position and mode of operation.

Hazard management plans should assess risks arising from interaction of multiple and varying items of plant in the stockpile area.

Any replacement or substituted machine should meet the same minimum requirements as the primary machine used on the stockpile. Replacement or substitution could be necessary due to unplanned issues such as breakdowns or repairs. Where specific safety devices are identified in risk assessments, any substitute or replacement machine operating in that environment should meet those requirements.

Specific safety devices and other equipment required for operation on stockpiles include:

- items specifically listed in the table in section 3.3.1
- coal blade or rock blade
- counterweight or ripper (or no rear attachment)
- remote fuel and lubrication attachment points
- remote fire suppression activation.

Dozer operators may be placed at significant risk of harm if safety devices are not functioning correctly. For example, when machines have unauthorised modifications or are poorly maintained.

3.2. Preventative controls

3.2.1. Stockpile design

The engineered design of material stockpiles should eliminate or minimise the risks identified in the site risk assessment. Matters to be considered in the system design include, but are not limited to:

- fixed infrastructure on the stockpile, such as support structures and perimeter sprays
- gantry heights and clearances
- the size of feeders
- stockpile footprint and containment bunding
- access ramps
- prevention of bridging and rat-holing
  - identifying and maintaining the material characteristics to achieve correct flow
  - drainage of the stockpile and surrounds to minimise accumulation
- means of identifying where draw points are
- discharge method and location for material from a skyline conveyor

- volume of storage
- reclaim capacity and blending requirements, including the number of draw points required to be operational at any one point in time
- the use of multiple machines on a stockpile
- the proximity and visibility of stockpiles to control room facilities
- whether or not the control room is occupied
- planning for significant changes in weather severity and extreme weather conditions
- response to potential emergency situations on the stockpile or in the reclaim tunnel.

Mine operators should implement change management principles where a change to the stockpile and recovery system is considered a risk to workers, equipment, or the environment. This should include conducting risk assessments, and where necessary, amending the hazard management plan.

The footprint of the designed stockpile area should be clearly marked. There should be space available within the footprint for safe access ramps to be constructed. The stockpile footprint with ramp locations, access roads and all relevant features should be communicated to all relevant workers at the site.

The location of access roads, drains, service easements and the entries to the reclaim tunnel should always be clear.

Access to the stockpile and reclaim area should be clearly delineated, and effectively control the access of workers and vehicles to the area.

The stockpile base and surface should be graded to allow water runoff and prevent the formation of central water reservoirs. The stockpile pad and immediate surrounds should be well drained to ensure the stability of the pad, stockpiled material, and surrounds.

Mine operators should have appropriate controls implemented to manage the risks of operating the stockpile and associated reclaiming systems, especially when operating at full capacity.

3.2.2. Stockpile high risk zones

Mine operators should identify high risk or no-go zones around feeders or draw points. The positions should be clearly delineated for dozer operators and others who are operating and maintaining the system. Similarly, mine operators should identify high-risk zones on the edges of the stockpile.

The size and shape of the high-risk zones may change due to stockpile dynamics. Mine operators should take a conservative approach to the size of the zones. They should establish processes to ensure that dozer operators are aware of the status of the high-risk zones on each shift.

A graduated system for identifying high-risk zones would identify areas of good compaction, areas of poor compaction, and areas where voids or bridging can occur.

The dozer operator should be made aware of the position of high-risk zones, including the precise location of the draw points and the overhead structures.

The means of determining the location of the draw point in all conditions in which the stockpile dozer is permitted to operate should be specified in the stockpile management plan, and through the dozer operator training procedures.

External navigation aids may assist in conditions where the dozer operator’s vision is impaired, or the dozer operator is distracted.

Such aids may include:

- cameras with video display units in the dozer operator’s cab
- GPS systems with indication in the dozer operator’s cab
- proximity detection devices

- sighter poles with lights
- reflective markers
- strobe lights
- laser lights.

Aids should be effective and reliable, and systems should be in place for alternative assistance where the primary system is liable to failure.

Audible warning alarms should be installed to alert the dozer operator, who may not see an alarm on a camera or GPS display while focusing on operating the dozer.

Controls for operation within high-risk Zones may include:

- delineation of the draw point through technology (GPS, radar, wireless, cameras or similar). Any system used should be proven reliable and robust
- back-up systems in case primary indicators fail
- dozer operator competence and training
- control of people entering the site
- fit-for-purpose equipment, such as dozers fitted with tilt switches or similar
- effective lighting
- ability to control feeder operation from the dozer operator’s cab
- communication between dozer operator and control room.

Mine operators should develop evaluation tools such as Trigger Action Response Plans (TARPs). TARPs determine the appropriate dozer operator’s actions in response to various operating conditions including impaired visibility. Actions should include triggers to determine at what level and to what extent restrictions are placed on operations.

3.2.3. Control of bench heights

Mine operators should assess the risk of equipment operating alongside relatively steep benches with heights above the safe limits of the equipment and develop appropriate controls.

Operation of dozers on the stockpile requires a risk assessment and the development of a safe method of work that considers equipment specifications and operational requirements.

Safe work systems should not require operation alongside bench heights that exceed safe operating parameters for stockpile dozers.

Mine operators should consider the use of different sized stockpile dozers in the development of the system. Mine operators should assess the suitability of equipment for the stockpile design and operating environment.

3.2.4. Design of product emplacement structures

Mine operators should design overhead structures to place product on the stockpile for potential interaction with mobile plant. Mine operators should implement engineered barriers or protective devices when the possibility of interaction between mobile plant and fixed structures cannot be eliminated.

Operating procedures should require dozer operators to report contact with structures immediately because structures may be damaged and at risk of failing.

3.2.5. Stockpile dozer cabin protection

Stockpile dozers should be fitted with rollover protection structure (ROPS) and falling-object protective structure (FOPS). The plant should comply with ISO 3471 (Earth-moving machinery – Rollover protective structures – Laboratory tests and performance requirements) and ISO 3449

(Earth-moving machinery – Falling-object protective structures – Laboratory tests and performance requirements).

Infrastructure on the stockpile should be inspected and maintained in accordance with applicable Australian Standards and the site Mechanical and Electrical Engineering Control Plans.

3.2.6. Stockpile access control

The stockpile risk assessment should address the movement of workers on the stockpile site. Mine operators should develop procedures so that only authorised and competent persons are permitted to enter stockpile and reclaim areas.

The names, position, and status of workers in the stockpile area should be always known. Systems for the control of persons accessing the stockpile area should include:

- induction of workers who inspect and operate the system
- signposting and control of access roads to the site
- authorisation of workers to enter the site
- competence of workers to operate items of plant
- supervision of workers on the site
- communication with dozer operators and others on the site
- emergency procedures
- the recording of activities.

Where possible, workers not operating stockpile dozers should not enter the stockpile area. Only essential work, permitted to be carried out under controlled safe work procedures, should take place.

Mine operators should develop a safe work procedure to provide for a safe means of accessing the stockpile for the inspection and maintenance of equipment in the stockpile area.

Mine operators should implement systems for control of workers and equipment on and around the stockpile and reclaim areas, including:

- communications protocols
- notification of stockpile status on each shift
- safe work systems
- monitoring and supervision of those tasks.

At all times, workers in the stockpile area should have the means to communicate with a control room operator or supervisor, and other workers on the stockpile.

3.2.7. Operational control

Dozer operators and other relevant workers on site should be made aware of the planned work program at the commencement of the shift, and any changes that may take place during the shift.

Work and changes to be communicated should include:

- the location of overhead discharge points in use or planned to be in use
- the location of feeder draw points in use or planned to be in use
- the status of visual and audible indicators and warnings
- operating and maintenance functions
- the location of ramps
- any planned maintenance activities.

The system should cater for the immediate stopping of draw-down feeders or valves if required by a dozer operator or control room operator in an emergency.

When draw-down feeders and valves are not operating, the draw points should be filled so that there are no voids to create a hazard for stockpile dozers.

Dozer operators should be notified before operations resume that may cause draw-down holes to form. Before resumption, stockpile dozers and operators and other workers on the stockpile should withdraw to a safe location.

Where possible, dozer operators should avoid and minimise compacting material over draw points.

Dozer operators should not operate directly under an active discharge or drop point.

Dozer operators should be assisted with audible and visual warning devices to help them locate a drop point and know if it is operating. These forms of assistance should include:

- indication within the dozer cab that an overhead discharge point is being relocated
- effective communication between the dozer operator and the control room operator.

Visual indicators, such as prominently placed lights, should be appropriately placed to warn personnel which feeders are operating.

Multiple redundant systems should be employed to cater for failure of the primary system.

Adequate and suitable visual cues should be available to allow the dozer operator to position themselves and navigate safely on the stockpile.

3.2.8. Dozer operator awareness and practice

Feeder rates should be governed so the feeder does not run empty. There are multiple factors to be considered when determining feeder rates. They include achievable dozer push rates based on the dozer operator and machine capabilities, the material recovery push distances, and working environment considerations. Feeder rates should not be governed by time-based loading requirements.

Mine operators should develop and implement procedures to ensure that dozer operators adopt a safe method of pushing material to feeder points.

Operating procedures for dozer operators should include the following practices:

- approaching draw holes directly and not at an angle
- communicating regularly with the control room operator on conditions and actions
- staying in the cab should a dozer go into a draw point, until advised otherwise.

Cameras should be positioned to provide the control room with clear real-time video of the stockpile dozer operating area if the stockpile is at a distance from the surface facilities.

During reclaim operations on the stockpile, control of the feeders should be always maintained.

3.2.9. Inspection

Mine operators should ensure the regular inspection of and reporting on stockpile condition, stockpile dozers, reclaim tunnel, feeders and valves, and any other relevant stockpile plant. Dozer operators, control room operators and maintenance workers should review this information before working on the stockpile.

The inspection routines should, wherever possible, avoid the need for workers to enter the stockpile area on foot.

The best viewpoint to assess stockpile status is often at the structure supporting an overhead discharge point. Surveillance from this point may be combined with other inspection methods. For example, visual inspection from a vehicle that can traverse the perimeter of the stockpile, and real time video footage.

3.2.10. Maintenance

Mine operators should develop plans for the management of maintenance and repair activities relating to stockpile infrastructure and equipment. Where necessary, these plans should include systems that limit the movement of overhead discharge points using mechanical stops or rail clamps. They should also include control system interlocks. These systems should prevent a mobile overhead discharge point from passing over a work area. For example, where maintenance work is being carried out on a feeder. Isolation procedures should also be developed to address this hazard.

Control system interlocking systems should undergo functional safety assessment to determine whether the level of reliability is suitable for the hazard being controlled.

Where a mine operator controls risk by using control system interlocking such as limitation of the discharge point movement, the system should undergo a functional safety assessment. The assessment will determine whether the level of reliability is suitable for the hazard being controlled.

Stockpile dozers should undergo maintenance in a safe location.

Recommended controls	Comment
The stockpile dozer cabin should be designed to withstand engulfment forces of at least 40psi (280kpa).	Designated force assumes a safety factor of 2:1 and is based upon USA stockpile dozer incidents and investigations.
Tilt switch/switches should be fitted to initiate engine shut down independent of the actions of the dozer operator. Tilt switches should operate in the event of excessive tilt, for fore and aft and sideways tilt.	• the tilt switch operating angle should be consistent with the stockpile dozer stability specification. • tilt switches may be by passed by the dozer operator after confirmation the dozer operator is in control.
Automatic fire detection and suppression, including manual activation for fire suppression should be used.	Should be installed to OEM dozer and fire system specifications in accordance with AS 5062.
Devices to assist the dozer operator in determining location of draw points in high-risk zones should be used. Audible and/or visual alarms should be provided to alert the dozer operator.	Devices to be considered include: • GPS, preferably with programmable 3D envelope showing no-go zones and proximity warning alarm capability • cameras over draw points • proximity detection • fixed structures to provide position reference (e.g., gantry).
Safety equipment to: • Ensure the dozer operator is in a safe atmospheric environment if the stockpile dozer cab is engulfed. • Facilitate rescue.	Devices to be considered include: • cabin air system • breathing apparatus — self-contained self-rescuer (SCSR) — compressed air breathing apparatus (CABA) • rescue harness

	• emergency lighting • method of communication between dozer operator and responders during an emergency.

Safe work systems should account for, address and control potential hazards such as plant breakdown on the stockpile. This includes protocols to safely access and repair the plant.

3.3. Mitigative controls

3.3.1. Dozer controls

The table below sets out the controls that mine operators should consider when assessing dozer engulfment risk. This includes engulfment in a draw point on the stockpile or being engulfed by rilling of stockpile material. Risk assessments should determine the effective controls required to manage this hazard.

The below list is not exhaustive. Mine operators should not rely solely on this list when deciding upon the required controls in their circumstances. Operation specific risk assessments should determine what other controls should be applied at the site. The identification of risk controls should be in accordance with the hierarchy of risk controls.

3.3.2. Stockpile dozer engulfment

Stockpile dozers should be designed to protect the dozer operator and allow operators to be quickly rescued from the dozer should engulfment occur.

The steep and unstable side and surrounds of the draw point may restrict dozer operator rescue efforts. Suitable aids for the safe recovery of a dozer operator should be readily available. The following should be considered:

- the use of an overhead stockpile conveyor system as a stable recovery platform (where an overhead conveyor is available)
- including a harness in the dozer operator's cab to enable the dozer operator to be lifted from the cab using a mobile crane
- the use of mats or portable bridges that can be placed to bridge the gap from stable ground to the engulfed dozer
- including breathing apparatus within the dozer operator's cab capable of supporting the worker for the duration of the recovery
- the stability of the dozer within the void
- additional risks associated with heavy recovery machinery on the stockpile.

Mine operators should consider the impact on a trapped dozer operator of sourcing and bringing in offsite recovery equipment. They should also consider the availability of the equipment and the time required to bring the plant on site.

Recovery plans and firefighting methods should be developed and tested.

3.3.3. Recovery of broken-down equipment

Mine operators should develop procedures for the recovery or repair of broken-down equipment on stockpiles.

A stockpile is a constantly changing work environment. It is highly unlikely that any two breakdown scenarios will be the same. Recovery procedures should include a requirement for a job safety analysis or a risk assessment and work procedure to be completed where it is established the recovery is a complex task. The risk assessment, as a minimum, should consider the following:

- Position and correct isolation of stockpile infrastructure including conveyors, trippers, stackers, reclaimers and draw-point feeders
- Safe access and egress to work area, including establishing no-go zones and restricted access areas
- Ground conditions, specifically considering:
  - proximity to potential voids or bridging in the work area around the equipment and in any area where recovery equipment may need to operate
  - slope stability.
- The selection of appropriately rated and fit-for-purpose towing accessories and equipment
- The location of recovery points on plant, and the ability to safely access and utilise those points
- Fire risk associated with undertaking in-situ repairs
- Positioning of people during recovery
- Interaction between people and plant
- How conditions or changing conditions may impact on task (eg lighting, rain, fog)
- Communications
- Lighting.

3.3.4. Recovery of bridging

Mine operators should develop procedures for the early detection and recovery of bridging.

Prevention, detection, and control of bridging should consider:

- designing draw points based on tests of the material (e.g., mechanical properties, shear characteristics and similar)
- a process for the early detection of bridging such as flow rate monitoring on draw points and reclaim conveyors

Note: trained and competent dozer operators will assist in this determination. An inspection within the reclaim tunnel may also detect bridging

- shutting down the feeder or valve when bridging is first detected

Note: in some circumstances this will limit the size of void or cavity that must be dealt with

- shutting down an operating overhead discharge point
- use of equipment, other than stockpile dozers, for removing bridging material.

3.4. Coal specific hazards and controls

3.4.1. Fire

Mine operators must assess the risk of fire and implement management controls. Means for preventing a fire, the early detection of a fire, and suppression of a fire, should be provided for a coal stockpile. Risk assessment should reference MDG 1032 Guideline for the prevention, early detection, and suppression of fires in coal mines.

Fire may develop on a coal stockpile due to:

- spontaneous combustion (refer to section 3.4.2)
- hot work on or around the stockpile (refer to section 3.4.3)
- failure of stockpile handling equipment, either electrically or mechanically, including dozers, front-end loaders, and trucks

- failure of stockpile fixed infrastructure, either electrically or mechanically, including overhead gantry conveyors, trippers, reclaim conveyors, feeders, and valves
- engulfment of stockpile handling equipment that contacts hot machine surfaces such as engines, turbos, and transmissions
- lightning strike.

3.4.2. Fire prevention

Preventing fires on coal stockpiles and in reclaim tunnels requires managing the interaction between flammable material and ignition sources. Preventative control measures include, but are not limited to:

- routine maintenance and inspection of plant
  - this is based on manufacturers' recommendations, and risk-based assessments of plant and equipment, to identify potential failure modes, and the maintenance, inspection and testing mechanisms required to prevent the failure
  - includes routine planned, preventative, defect, and corrective work order maintenance, as well as pre-use, once-per-shift, and daily inspections by dozer operators, fitters, and electricians

Note: Refer to MDG 15 Guideline for mobile and transportable plant for use at mines (other than underground coal mines) 2017 for additional guidance

- control of fuel and ignition sources on mobile plant
  - this includes managing diesel and oil hoses and piping to prevent spraying fluids and controlling hot surfaces to prevent an ignition.

Note: Refer to MDG 15 Guideline for mobile and transportable plant for use at mines (other than underground coal mines) 2017 and AS5062 Hire, prevention and protection for mobile and transportable plant for additional guidance.

- monitoring systems
  - intended for the early detection of potential failure of plant and equipment
  - for operating parameters such as power draw, speed, slip, temperature, and vibration.

Note: The monitoring systems are primarily electronic, and alarm and trip limits can be implemented to protect equipment from catastrophic failure.

- housekeeping standards
  - to help prevent the build-up of coal spillage, fines, and dust around plant and equipment
  - to help prevent the generation of heat from sources such as motors, gearboxes, bearings, rotating elements, etc.

3.4.3. Fire mitigation

Mitigation of fires on coal stockpiles, or within reclaim tunnels, requires the detection and suppression of heating events. Mitigation control measures include, but are not limited to:

- fire detection and activation systems
  - these may include carbon monoxide gas monitors and smoke detectors that activate the fire suppression system, the use of fusible link deluge systems or glass bulb spray nozzles on a pressurised fire system
  - these systems do not rely on action by workers.

Note: It should be noted that these systems may not always direct the optimum water flow to the most active part of the fire.

- hydrant system around the perimeter of stockpiles and on aerial conveyor gantry
  - these are dedicated firefighting systems that may be supplied by pump from a site water storage facility, and use hydrants, fire depots, fire hose reels, and extinguishers
  - mine operators should risk assess the requirements, capacity, and placement of fire equipment, including booster pumps, and determine any required action to be taken on a loss of water pressure in the system
  - the capacity of the system should provide adequate flow and pressure for the purposes of firefighting (refer to MDG 1032 Prevention of coal mine fires).
- reticulated stockpile spray systems
  - these systems often utilise process or recycled water reticulated around the perimeter of the stockpile and/or along overhead gantries primarily for dust suppression
  - these systems may be controlled either manually or by a site weather station using wind and temperature data
- site water cart fitted with monitor and foam generator
  - the monitor should be remotely controlled to allow the water cart operator to remain safely within the cabin and allow them to activate the foam generator
- fire suppression system on stockpile equipment
  - the primary function of these systems is to allow the safe egress of workers from mobile plant. Extinguishing of the fire is a secondary consideration
  - the system should be able to be activated from within the dozer operator’s cabin and externally. Consideration should also be given to remote initiation of these systems.

Mine operators should regularly inspect and test any installed systems to ensure their effective operation in the event of a fire.

A firefighting plan should be formulated, which should include:

- training in awareness of the fire hazards on the stockpile, and risk to workers from various types of fires
- training in the operation of the fire suppression systems installed
- requirements for maintenance and inspection of the fire suppression equipment
- the level and nature of communication needed during a firefighting emergency.

In developing controls, mine operators should be aware deep-seated heating can vaporise water it encounters. For example, water from stockpile sprays, conveyor sprays and water injection lances. This can result in the rapid expansion and ejection of material. Steam flashes, also known as rapid phase transitions, occur when water contacts very hot material. Water can flash to steam, which increases its volume an estimated 1700 times (1700:1). This may introduce additional risks that also need to be controlled.

3.4.4. Spontaneous combustion

Coal that has been stockpiled for some time can spontaneously combust.

While all coals are at risk of spontaneous combustion, some types of coal have a higher tendency than others. The development of spontaneous combustion can be difficult to see or detect. It takes place beneath the surface of the coal and is often not detected until the combustion is well advanced.

At lower temperatures, the development of spontaneous combustion produces carbon dioxide and carbon monoxide. At higher temperatures, it produces methane, hydrogen, ethylene, and other hydrocarbons. Hydrogen and the higher hydrocarbons will form explosive mixtures with air.

Conditions that contribute to the development of spontaneous combustion include:

- steep uncompacted sides – particularly those facing prevailing winds
- maximum height of stockpiled material
- infrequent removal and replacement of the material
- prevailing wind direction and magnitude
- rainfall, leading to increase in moisture
- material size distribution and degradation from mechanical interaction of equipment.

Risks of harm to dozer operators because of spontaneous combustion include exposure to smoke, flames, and combustion by-products. For example, carbon dioxide and carbon monoxide. Deep-seated heating that develops over time may also cause the base material to be unstable.

Spontaneous combustion and fire may also have impacts on the atmosphere, temperature, and visibility within the dozer operator's cab.

Effective controls that address the risk of spontaneous combustion include:

- detection of rises in temperature in areas of the coal stockpile
- compaction and grading of areas of low compaction and steep slopes facing prevailing winds
- the regular removal and replacement of coal on the stockpile to minimise the impacts of oxidation and retention of heat
- recording results of temperature monitoring and coal movements to establish recurring patterns in the tendency of the coal to heat in specific conditions on the stockpile.

Spontaneous combustion typically develops as small "football" sized shapes within larger masses of coal. Most of the stockpile does not initially heat. Those small shapes will increase in size when not treated.

Mine operators should monitor temperatures in numerous locations across the stockpile rather than just one or two. Mine operators cannot extrapolate temperature data at any one spot across other locations in the coal mass with accuracy.

TRG Spontaneous combustion provides detailed guidance on managing the risk of spontaneous combustion.

3.4.5. Hot work

Hot work includes cutting, grinding, and welding operations. This work may happen on or above the coal stockpile, on stockpile handling equipment or fixed infrastructure, or within a reclaim tunnel. Hot work has the potential to ignite a fire within the large volume of flammable material present.

A site's mechanical engineering control plan should specifically reference this hazard. It should also include a risk assessment that identifies relevant controls, detailed in the site hot work management plan.

Mine operators should develop procedures with consideration to the TRG Hot work (cutting and welding) at mine and petroleum sites (formerly MDG25: Safe cutting and welding), and the implementation of an effective hot work permit that includes:

- preparation of the area
- assessment by a competent supervisor
- competency of tradespeople
- availability of suitable firefighting equipment
- watching for the outbreak of fire after work has finished.

Mine operators should also consider special precautions to stop hot slag falling onto the coal stockpile from hot work on any overhead gantry.

4. Reclaim tunnels

4.1. Operational design

The reclaim tunnel structure and major components should be designed for the life of the facility. The structural design should be based upon the maximum expected future stockpile loading. Where this has not occurred, there is potential for the catastrophic failure of the tunnel, plant, or structures. Mine operators should provide for its upgrade or replacement. The frequency of review of the structural integrity should be considered.

Structural integrity review of the tunnel and associated structures should be conducted based on the outcomes of a risk assessment. The age, size, condition, and design factor of safety should be considered in determining the review scope and frequency.

Periodic inspections by a competent structural engineer should take place where the failure of any infrastructure may affect the health and safety of workers. A structural engineer should conduct any such recommended inspections. Additional non-routine inspections may also be required after accidents and environmental events such as bad weather.

Further information is available in the NSW Code of practice: Mechanical engineering control plan.

Mine operators should consider the shape and size of the vaulted or recessed chambers that house valves and feeders. This will ensure that there is adequate airflow through these spaces and to reduce the risk of dust and gas accumulation.

The design criteria for the reclaim tunnel should be recorded. Any proposed modifications to the tunnel or stockpile should trigger a structural assessment and review. The review should be based on the original design and the scope of the proposed changes.

Material or other debris should not be stockpiled within or near reclaim tunnel entries.

The ventilation fan and ducting should not obstruct any access/egress to the tunnel.

Mine operators should maintain a drainage system capable of diverting flows from heavy rainfall and accidental water system flow failures. This will prevent uncontrolled inrush of water and material into the tunnel.

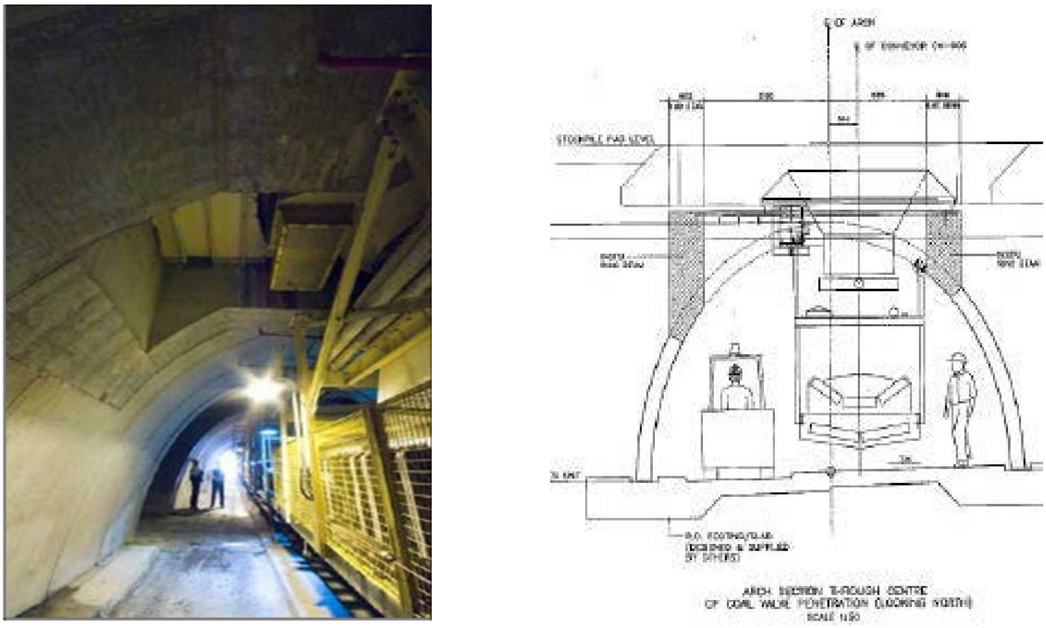
The conveyor drive and associated electrical equipment should be outside the reclaim tunnel and clear of ventilation flowing into the tunnel. Any associated electric equipment such as the substation and starter should also be outside the reclaim tunnel. This design consideration reduces the risk of fire and contamination of the tunnel atmosphere from the substation or conveyor drive.

There will be circumstances that require the tunnel conveyor belt to be cleared following an unexpected system stoppage. Mine operators should consider providing bunkerage between the tunnel conveyor and any conveyor onto which it discharges.

There should be enough clearance to enable safe continuous access to both sides of the conveyor belt installed in the reclaim tunnel. AS4024.3610 and AS4024.3611 specify minimum clearances. The specified clearances may not be adequate in some circumstances. An increase in clearances may be required for:

- transport of an injured person on a stretcher
- the use of a skid-steered vehicle or equivalent for cleaning the tunnel
- transport of replacement components in the tunnel.

Figure 6: Reclaim tunnel showing coal valve and access way alongside conveyor.



The tunnel should be graded so that it is self-draining with no risk of flooding or ponding.

Services in the tunnel should be located with due regard to ready access, cleaning of structures, efficient ventilation, and prevention of damage by the passage of equipment.

The conveyor system should conform with AS 4024.3610 and AS 4024.3611 as far as reasonably practicable. Mine operators should also consideration the requirements described in these standards for conveyors used in underground coal mining.

All conveyor belting and other rubber components in the feeder/valves and conveyor system should be rated FRAS material in accordance with regulatory requirements. This includes components such as skirting, belt cleaners, V belts, impact rollers and lagging.

Mine operators should develop an effective and efficient method of cleaning of the reclaim tunnel. Sloping the reclaim tunnel to a minimum of 1 in 100 will facilitate drainage. A cross grade and gutter can be used to provide increased water flow to assist with hosing down. Tunnel arrangements that allow water to form ponds or become flooded should be avoided.

Sometimes it may be necessary to use pumps and sumps within the tunnel. In these situations, the system capacity should exceed the maximum expected water flow and the maximum material lump size.

The return conveyor belt and support idlers should be high enough to allow for inspection and cleaning. Dust deposited on the structure and roadway should be periodically removed or cleaned, preferably by hosing.

Applicable standards and guides for the design of reclaim tunnels and conveyor systems include:

- AS 4024.1 – Safety of machinery - series of standards
- AS 4024.3 – Safety of machinery – series of standards including:
  - AS4024.3610 Conveyors – General requirements
  - AS4024.3611 Conveyors – Belt conveyors for bulk materials handling

Technical reference guide Hot work (cutting and welding) at mine and petroleum sites (formerly MDG25 Safe cutting and welding).

4.2. Specific hazards

4.2.1. Accessing the reclaim tunnel

Control room operators may not expect workers to be within a reclaim tunnel because they are only occasionally required to work in them. This could lead to hazardous situations.

Control room operators should authorise access to reclaim tunnels for all work activities. This includes inspection, cleaning, and maintenance activities. Control room operators should use logging and tracking systems to identify when workers are in a tunnel. Workers should only enter a reclaim tunnel once authorised.

Access to the reclaim tunnel could be hazardous to workers in the following circumstances:

- where workers have not received instructions on the hazards and controls that have been developed to manage safety in the tunnel
- an unsafe condition has developed in the reclaim tunnel (e.g., accumulation of gas, cessation of ventilation, outbreak of fire or similar) and workers are not aware of the condition
- workers in the tunnel suffer an injury and other workers on the mine site are unaware of the workers' location
- entry authorisations and permits to work are unclear or ambiguous.

4.2.2. Alternative exit

Reclaim tunnels could become blocked so that there is no exit available to workers in the tunnel. This could expose workers atmospheric contamination, flooding, fire, inundation of stockpile material and other risks.

Tunnels may become blocked due to:

- inflow of stockpile material through draw points or entrances to the reclaim tunnel
- flooding through rainfall and stockpile water inflows
- conveyor malfunctions
- fire and heating
- gas accumulation or explosion.

The reclaim tunnel should have an alternative exit to provide an escape route in case the primary entry is blocked. All exits should be risk assessed to determine minimum requirements.

The primary entry and alternative exit should both provide for transport of an incapacitated worker on a stretcher. The location of exits should consider the distance injured workers may need to be conveyed, and the support requirements for injured people.

The alternative exit should be clearly marked, adequately ventilated, well maintained (e.g., clear of debris, water, and atmospheric contamination) and well lit.

4.2.3. Atmospheric contamination

Atmospheric contaminants within the tunnel may become harmful to workers due to:

- gaseous products from a stockpile material fire, spontaneous combustion, or surface fire (including bushfire)
- products of combustion from flammable materials within the tunnel
- gaseous emissions, such as methane, carbon dioxide and hydrogen sulphide, from the stockpile material
- reduced or blocked ventilation
- hazardous chemicals

- hot work activities
- generated by mechanical apparatus in the tunnel
- diesel vehicle emissions
- high levels of airborne dust.

For further Information, refer to the Airborne contaminants principal hazard management plan Guidance for the NSW mining and petroleum industries and Safe Work Australia's Workplace exposure standards for airborne contaminants and the associated Guidance on the interpretation of Workplace exposure standards for airborne contaminants.

Worker exposure to airborne dust over an extended period is a health risk. The minimum expected airflow and environmental quality must be specified and monitored against TARPs and alarm set points.

Chutes should be designed to minimise dust generation and should include dust suppression systems.

4.2.4. Noise

Workers should not be exposed to noise that may cause hearing loss or any risk to health and safety. In addition, noise levels should not exceed the relevant workplace exposure standard.

4.2.5. Ventilation

Where the hazards of airborne dust, atmospheric contaminants and desorption of gas have been identified, all accessible parts of the tunnel, should be ventilated. This includes primary and alternative exits.

The ventilating fan motor and starter and reticulated supply cables should be positioned to eliminate the risk of running or restarting a fan in an unsafe atmosphere.

Workers should be prohibited from entering, or remaining in, the reclaim tunnel if the ventilation system stops working. The hazard management plan or task specific risk assessment should set out controls for performing repairs.

Vaulted and recessed areas that are not in the direct airflow along the tunnel may require tailored design considerations to ensure ventilation. For example, hurdles or similar.

Some sites may use fans to manage airflow within a reclaim tunnel. In these situations, mine operators should develop specific controls to manage power loss. They should also develop required protocols to restore power to the fan.

Ventilation systems should undergo efficiency audits following commissioning to confirm the requirements and standards are met. The audit should be repeated when the stockpile approaches planned capacity, and periodically according to the risk potential of the tunnel. The ventilation audit should determine the requirements to dilute and disperse atmospheric contaminants in the reclaim tunnel. It should also address the performance and efficiency of the fan in producing required airflow in the tunnel.

The workers auditing ventilation should be competent, and appropriately trained and qualified (e.g., ventilation officer). Some ventilated areas require the use of gas monitoring equipment. In these situations, supervisors, employees, and contractors should be trained in the identification, control and awareness of alarms and personal protective equipment requirements. This should cover both normal and emergency situations.

Homotropal ventilation should be used with the airflow travelling in the same direction as the coal flow. This will reduce airborne dust and unwanted gas levels.

If a fire develops within the reclaim tunnel, mine operators should consider continuing ventilation to control the risk of an explosion of flammable gases distilled from the coal.

4.2.6. Electricity

Electricity exposes workers to the risk of electric shock and electrocution, especially when electrical currents are exposed to water. Reclaim tunnels are often damp or wet environments. This is due to the use of water for dust suppression, continual cleaning, and drainage associated with the stockpile above. It can also be due to the inflow of natural groundwater.

Voltages above extra low voltage (ELV) are used for feeders and pumps as well as lighting systems. Some tunnel installations also use control system voltages above ELV for operator control stations and emergency stop buttons. This increases the likelihood and consequence of electric shock. To minimise the risk of electric shock and electrocution, tunnel control system voltages should be as low as reasonably practicable. This is typically below 25 volts and preferably Direct Current (DC).

The Ingress Protection (IP) rating for all electrical equipment should be at least IP55 (as defined in AS 60529). This should be higher where there is a risk that workers in the tunnel may be hosed or sprayed with water.

Electrical equipment and enclosures should be placed away from water sources. This includes jets of water from hosing or continual exposure to dripping water or sprays from dust suppression. Poorly designed, installed or maintained installations also pose a risk of electric shock, electrocution, or fire. This is due to inadequate electrical or mechanical protection of electrical apparatus and cabling systems.

Safeguards for electrical and non-electrical hazards should have a probability of failure appropriate to the degree of risk posed by the hazard. Mine operators should perform functional safety assessments on safety critical functions within the reclaim tunnel that accord with recognised safety standards.

Power within the tunnel should be able to be isolated from a point outside the tunnel.

Electricity can be an ignition source for gases and dust within the reclaim tunnel, caused by arcing or sparking, or from thermal effects. Ignition events are commonly caused by damage to equipment. Overheating may also occur where spillages or accumulations of dust and fines that inhibit cooling of equipment and cables.

For reclaim tunnels in coal mines, a hazardous area classification assessment should be made in line with the requirements of AS/NZS 60079.10.1 Explosive atmospheres – Classification of areas – Explosive gas atmospheres and AS/NZS 60079.10.2 Explosive atmospheres – Classification of Areas – Explosive dusts.

Note: These assessments are a requirement of AS/NZS 3000.

Hazardous area assessments in accordance with AS/NZS 60079.10.1 (gases) and AS/NZS 60079.10.2 (dust) should be made by people with appropriate skills, knowledge, and experience in assessing hazardous areas. These assessments should consider hazards associated with both gases and dusts.

Electrical equipment for use in areas identified as hazardous should be selected in line with the requirements of AS/NZS 60079.14 Part 14: Electrical installations design, selection, and erection.

A maintenance regime should be established to mitigate the risk of electrical installations in the tunnel becoming ignition sources. Maintenance regimes should address the adequacy and frequency of electrical installation inspections, including both external (visual) and internal examinations.

Electrical installations within the reclaim tunnel must comply with the requirements of the Electrical Engineering Control Plan for the site.

4.2.7. Fire

Mine operators should ensure that any fire in a reclaim tunnel is:

- prevented by using appropriate means to control fuel and ignition sources

- detected as soon as possible
- monitored with appropriately selected alarm set points for mechanical defects, electrical failure, and combustion products
- brought under control as soon as possible.

A fire involving conveyor belting is a significant hazard which exists in all reclaim tunnels. This risk must be managed through appropriate controls. Section 90 of the Regulation requires conveyor belting and conveyor accessories used in a reclaim tunnel at a coal mine be FRAS. The operators of all mines should consideration the use of FRAS conveyor belting in reclaim tunnels, not just in coal mines.

Fires involving electrical cables often emit toxic and corrosive gases. Low smoke zero halogen cables reduce the amount of toxic and corrosive gas emitted during combustion. They should be considered for use on control, communication, and power circuits within the reclaim tunnel.

4.2.8. Explosion

Gases such as methane that are emitted from stockpiled coal are explosive in certain concentrations (approximately 5 to 15 per cent). Gas ignition requires a mixture of methane and air combined with an ignition source.

Coal dust accumulations within a tunnel may also pose an explosive hazard. A gas explosion can spread and ignite a coal dust explosion.

4.2.9. Flooding

Flooding can be a gradual or a sudden catastrophic event. Heavy rain and flooding can cause an inrush, or inundation from the material stockpile area through a draw point, or through entrances to the tunnel.

Such events can cause direct harm to workers and can also block tunnel exits.

4.2.10. Conveyor failure

Failure of the conveyor in the reclaim tunnel can cause direct harm to workers or impede access through:

- structural failure and sudden displacement of conveyor drive-head and boot-end including belt structure
- fire due to bearing failure of main pulleys or idler rollers or another frictional ignition cause
- excessive spillage of conveyed material.

4.2.11. Draw point equipment failure

Draw-down systems include:

- feeders
- valves/gates
- ploughs
- chutes.

Failures to these systems can occur due to changes in the head feed. Environmental conditions such as heavy rain and flooding that change material flow characteristics can also cause failures to the above systems.

Hazard management plans should consider the possibility of a significant head of water or water/coal slurry existing above a feeder point.

The ongoing presence of water in the draw point environment also poses a long-term risk of corrosion affecting the life of this equipment.

4.2.12. Maintenance on feeders and valves

Workers performing maintenance on feeders, valves, chutes or similar are at risk from engulfment, and inadvertent operation of machinery (gates and rams).

All tasks where engulfment may occur must be documented and subjected to a risk assessment.

4.3. Monitoring and inspection

4.3.1. Gas monitoring

Gases that can be emitted from coal, or develop through heating and fire, should be identified and the hazards and risks at the site assessed.

Mine operators must consider the application of section 77 of the Regulation to reclaim tunnels.

It is important to have a system of monitoring and inspection for the detection of accumulation of dangerous gases.

Sometimes a mine operator may determine that a tunnel requires fixed gas monitoring sensors (also refer to the hazard action control (HAC) assessment). In these situations, the reclaim tunnel design and operations should include the following:

- a gas content monitoring system that
  - monitors the gas content of the air in the tunnel
  - identifies the locations of monitoring points
  - details each type of gas being monitored
  - details the alarm or trip level (being the gas concentration level at which alarms will be activated or the supply of power will be cut to plant or a place (or both)
  - details who are authorised to set or change those alarm levels and how those alarm levels or changes to those alarm levels are to be recorded
  - details who is responsible for acknowledging when those alarm levels are reached and recording those acknowledgments
  - details who is responsible for communicating that an alarm level has been reached and initiating action because of reaching that level
  - details response plans to be activated because of an alarm level being reached
  - details how the actions of workers in response to an alarm level being reached (and the identities of those workers) are to be recorded.
- documentation of the gas content monitoring system
- an accurate plan of all gas monitoring for the tunnel that specifies the locations at which air is monitored (and is updated as required)
- detection heads for gas monitoring positioned to maximise the likelihood of detecting the gas being monitored and produce accurate readings
- a safety management system that specifies the alarm level for each type of gas, including a requirement that a record is kept of all events where an alarm level is reached
- all gas content monitoring plant is calibrated and maintained (refer to AS/NZS 2290.3 provides guidance on maintenance and calibration),
- gas monitoring plant has an alternative power supply to help ensure the plant continues to function if the normal power supply fails so far as is reasonably practicable
- gas content monitoring plant that automatically activates an alarm or cuts the supply of power if an alarm trip level is reached.

Consideration should be given to monitoring the following gases on the site, if applicable:

Gas	Details
Methane (CH_4)	Procedures should be developed to implement appropriate precautions where a concentration greater than 5% of the lower explosive limit (LEL) is detected and a TARP developed to manage the mine's response. For example, at pre-determined alarm and trip levels evacuate personnel, turn off all non-explosion protected electrical circuits and ventilate the area. Methane can be desorbed from coal. Methane has a density relative to air of 0.554 and is most likely to accumulate at roof level in the upper parts and poorly ventilated areas of the tunnel (such as those that house the feeders). Methane is explosive in the range of 5% to 15% in air. Methane can be monitored with a wide range of certified explosion protected portable and fixed gas detectors.
Carbon dioxide (CO_2)	Carbon dioxide is a colourless gas with a relative density to air of 1.53 and hence is likely to accumulate in downhill dead ends and sumps. High concentrations of carbon dioxide in the air cause a deficiency of oxygen with the risk of loss of consciousness or death. TWA Underground Coal Mines – 12,500ppm and STEL of 30,000ppm. TWA all other mines Mines– 5,000ppm and STEL of 30,000ppm.
Carbon monoxide (CO)	Carbon monoxide is a colourless, odourless, tasteless, toxic gas with a density relative to air of 0.97. Carbon monoxide is not desorbed from coal. Its presence usually indicates a heating or a fire (also a product of diesel exhaust). Carbon monoxide is both flammable and explosive. The flammable limits in air are 12.5% to 74% with the most explosive concentration being 29%. *Workplace Exposure Standard for Airborne Contaminants* published by SafeWork Australia. See www.safeworkaustralia.gov.au.
Hydrogen sulphide (H_2S)	Hydrogen sulphide is a colourless gas that is produced form the decay of organic materials and is a naturally occurring seam gas in some coal and shale deposits. It can be detected by smell at small concentrations as low as 1ppm. Smell is an unreliable warning detector as nasal sensitivity decreases with exposure and increased concentration levels. Hydrogen sulphide is highly toxic - exposure to concentrations greater than 500ppm can be fatal. Hydrogen sulphide has a density of 1.19 relative to air and as such, will tend to pool and stagnate in wells and poorly ventilated areas. It forms flammable mixtures in air in the range of approximately 4.5% to 45%. Refer to *Workplace Exposure Standard for Airborne Contaminants* published by SafeWork Australia. See www.safeworkaustralia.gov.au

Gas	Details
Sulphur dioxide (SO_2)	Sulphur dioxide is a colourless gas with a strong pungent odour that is heavier than air with a relative density relative to air of 2.26. Sulphur dioxide is produced by the combustion of sulphur compounds and is usually found in the vicinity of heating in coal containing sulphur. Refer to Workplace Exposure Standard for Airborne Contaminants published by SafeWork Australia. See www.safeworkaustralia.gov.au
Oxygen (O_2)	It is unlikely that concentrations of desorbed gases will reduce oxygen to unsafe levels, however this cannot be ignored. The exposure limit for people is 19.5% to 23.0%. In most circumstances, the detection of methane and carbon monoxide should provide a satisfactory level of control for accumulations of gas in reclaim tunnels and the early development of fire. For coal mines, the particular coal types and risk of gas accumulation should be assessed before making that determination. Coals that emit carbon dioxide and the presence of low-lying areas in the reclaim tunnel would indicate a requirement for monitoring of this gas.

Coal can break up into smaller pieces when mined and transported from the underground or open cut mine. This causes gases to be released from the coal. As such, the residual values of gases in the coal stockpile areas are much lower than at the mining area.

Measuring the range and value of gases given off from coal on the stockpile assists in determining the level of risk and degree of monitoring required to control the risk.

Varying grades of coals are often handled in a stockpile and reclaim system. A conservative approach should be taken, accounting for the gassiest product and the range of gases likely to be encountered.

Measurements of gas levels should be linked to action plans or TARPs.

Where there is a risk of flammable or explosive gases, all sections of the gas monitoring and detection system in the tunnel should be certified as intrinsically safe to ‘Ex ia’ (see AS/NZS 60079.11). The certification should be referenced to the hazard classification.

There should also be a methane detector in the general body of the roadway near the ventilation exit point. The placement of a carbon monoxide detector near the ventilation exit point may provide early warning of fire or spontaneous combustion.

Figure 7: Ventilation airflow Fire advanced warning – CO vs. temperature

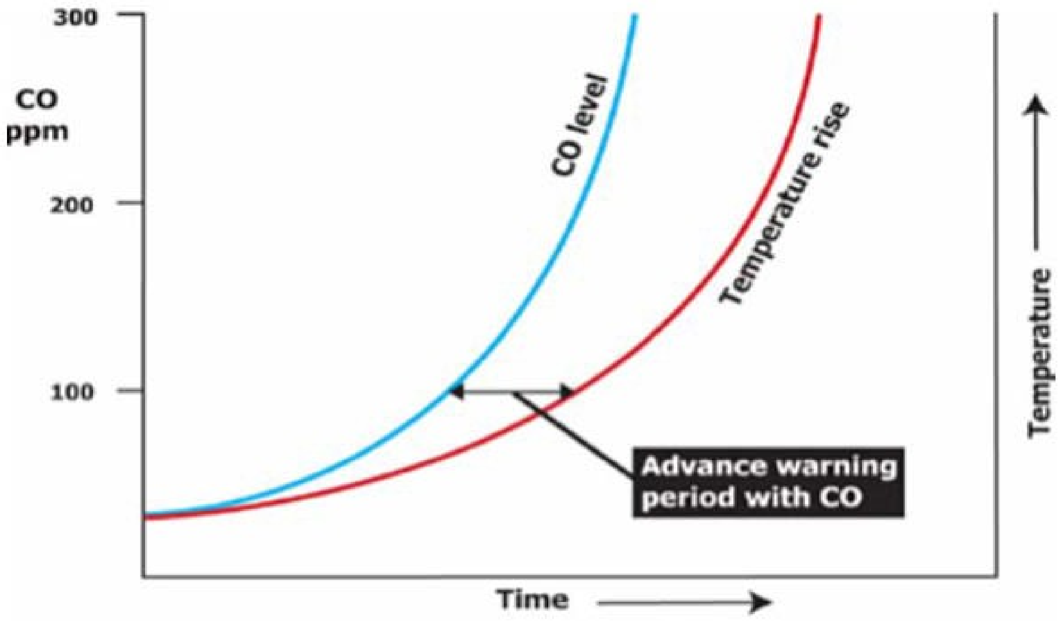
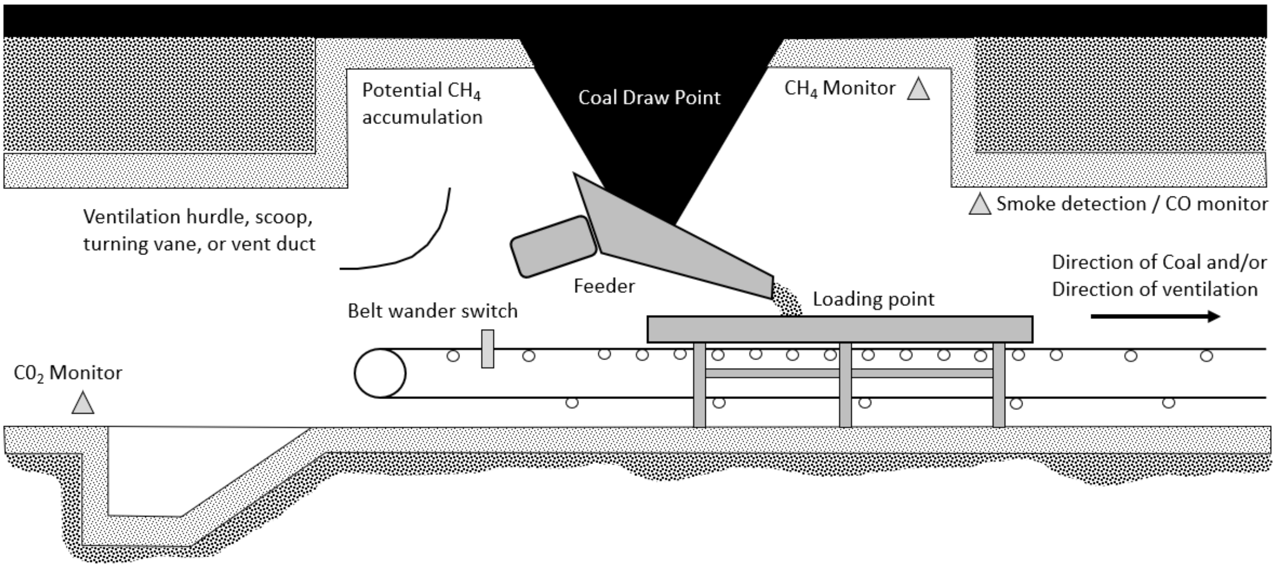


Figure 8: An example of atmospheric controls in reclaim tunnels including coal



The set limits and system shut down values for methane should consider legislation and safety factors and be as low as reasonably practical. For other gases, the standards should meet the Safe Work Australia workplace exposure standard for airborne contaminants.

Where an accumulation of gas can cause a serious risk to workers, monitoring and reaction should not be limited to a screen display in a monitored control centre and a TARP. Reactive alarms to alert control room and dozer operators to the hazardous condition and automatic removal of power provide more rapid and positive responses to control the risks.

4.3.2. Reclaim tunnel inspections

The reclaim tunnel should be inspected regularly to confirm that the tunnel and other equipment and infrastructure are all in a safe operating condition. This includes conveyors, feeders, coal valves and chutes, ventilation, power and water supply, communication and lighting, firefighting system, and gas monitoring equipment. The frequency of inspection will depend on the level of risk, along with several other factors. These include site electrical and mechanical engineering control plans, the original equipment manufacturers (OEM) recommendations, and any standards that apply for reclaim tunnels.

Some inspections should be conducted after an event has occurred, rather than after a period. The reclaim tunnel should be inspected after reclaim operations for the purpose of identifying heating sources. These include defective rollers, poor tracking of belts or similar, and for accumulations of spillage and dusts.

4.3.3. Start-up and shut down systems

The tunnel conveyor should have an audible and visual alarm that alerts reclaim tunnel workers that the conveyor system is starting. The alarm should be audible for the full length of the tunnel.

Conveyor signalling and emergency stop systems should comply with the requirements of AS4024.3610 and AS4024.3611.

Appropriate controls should be developed to manage the start-up, shut down and restoration of power to the fan.

Figure 9: Entrance to reclaim tunnel

Awareness devices within the tunnel should prompt workers to evacuate if conditions are unsafe. Workers entering the reclaim tunnel should be required to:

- contact a control room operator on site before entering and advise of their intention to enter
- carry a communication device
- advise the control room operator on site when they have left the tunnel.

All entrances and exits to the tunnel should be kept clear of obstructions and debris and negate the possibility of material to 'rill' or 'fall' over the tunnel.

4.3.4. Communication

Workers in a reclaim tunnel need to be able to contact other workers that can remotely affect or control the operation of machinery in the tunnel. Mine operators should provide a communication system to facilitate this.

Communications systems can vary. They could involve the use of handheld radios, or a fixed system providing communication between the reclaim tunnel and a monitored control room or other location. Mine operators should determine the appropriate communication system based on risk.

Regardless of the style of system implemented, it should enable communication with a worker at any location within the reclaim tunnel. This includes at entries and alternative exits.

Failure of the ventilation system within the tunnel should not impact on the effectiveness of the communications system.

There should contingencies for a failure of the primary communication system. This could be an alternative means of communication, or a requirement to evacuate the reclaim tunnel in case the communication system fails.

The system of communication should ensure that the control room operator (or equivalent) is aware that the reclaim tunnel is occupied and that the number and identity of workers in the tunnel is known.

4.3.5. Fire

Mine operators must assess the risk of fire on any belt conveyor in a reclaim tunnel and implement controls to manage that risk. For coal mines, conveyor belt and accessories in the reclaim tunnel must be FRAS. Section 4.1.5 provides detail on the management of fire and FRAS requirements.

Reclaim tunnels should contain means of preventing and suppressing fire, and the early detection of fire. These requirements are outlined in MDG 1032 Prevention of coal mine fires.

Mine operators should install a system to suppress fire on the conveyor. It may be a sprinkler system or a deluge system, and a system that combines hydrants, hoses, branches, and nozzles.

Fire suppression systems should be designed so that workers can approach a fire from the intake or clean air side when ventilation is flowing in the normal direction.

To minimise fire risk, reclaim tunnels should be designed so that any high-risk components are located outside the tunnel. These include electrical equipment, tail-end pulleys, and pumps. Fire extinguishers should be placed at high-risk areas such as those that house electrical equipment listed above.

Bearing temperature monitoring (e.g., remote temperature device [RTD]) should be considered on all main pulleys inside the tunnel.

Reticulated firefighting equipment should be selected, positioned, and oriented in the tunnel. This includes hydrants, hose reels, hoses, and nozzles. The direction of the ventilation, equipment accessibility, and the safest direction to fight a fire should also be considered.

Firefighting depots containing back up equipment and tools should be located outside the tunnel where such equipment can be readily accessed.

Systems that are installed should be regularly inspected and tested to ensure they will operate efficiently if required.

A firefighting plan should be developed. Provisions of the plan should include:

- training in awareness of the fire hazards in the reclaim tunnel and risk to workers from possible types of fires
- training in the operation of the fire suppression systems installed in the tunnel
- requirements for maintenance and inspection of the fire suppression equipment
- the level and nature of communication needed during a firefighting emergency.

4.3.6. Lighting

All accessible parts of the tunnel (including entries and exits) should be well lit.

It is recommended that multiple circuits be provided with adjacent lights on different circuits. This is so that the failure of one circuit would not result in a complete loss of light in any large sections of the tunnel.

Provision should be made for emergency lighting should the power supply or primary system fail.

Where the hazardous area assessment has identified a risk of accumulation of flammable gas or dust, emergency lighting and communications equipment should be capable of being left on safely in a hazardous atmosphere. These systems should be certified as suitable for the classification of the area as determined through assessment.

4.3.7. Emergency equipment

Risk assessments should consider the required emergency equipment for use in a reclaim tunnel. This equipment may be located on site or capable of being readily sourced through external providers. Resources may include:

- breathing apparatus for rescue in a hostile atmosphere
- harness and special equipment for rescue from heights or sumps
- equipment for fighting fires
- extrication gear for removing heavy equipment and debris.

A stretcher designed for use in the reclaim tunnel should be located near the entrances to the tunnel. Where longer tunnels may make the use of a stretcher impractical, wheeled trolleys should be considered.

4.3.8. Maintenance

Life cycle maintenance plans should apply for all equipment within reclaim tunnels.

Maintenance work that is conducted should comply with the relevant mechanical or electrical engineering control plans.

Structural integrity audits of the reclaim tunnel must be completed. They must accord with requirement set out in the site mechanical engineering control plan. The frequency of these audits is also detailed in these plans.

5. References

5.1. Definitions

Term	Meaning
airborne contaminant	Means a contaminant in the form of a fume, mist, gas, vapour, or dust, and includes microorganisms. An airborne contaminant of this type is a potentially harmful substance that is either not naturally in the air or is present in an unnaturally high concentration and to which workers may be exposed in their working environment.
angle of draw	Angle to the horizontal made by the edge of a stockpile where the material has been stationary and overcome surface friction to be drawn away from the stockpile
angle of repose	Angle to the horizontal made by the edge of a stockpile where the material has come to rest after being dropped onto the stockpile (like rill angle).
bridging	A condition in which the hole above a draw point for an operating feeder does not open at the surface of the stockpile. It is also known as doming, voiding and cohesive arching.

Term	Meaning
product emplacement structures	Structures used for the support of gantries and the placement of product onto a stockpile. For example, rill towers, conveyors, trippers, slingers etc.
stockpiles	The stockpiles referred to in this guideline are of a size that require stockpile dozers to be used to facilitate handling requirements. In most cases these stockpiles are over a reclaim tunnel. Stockpiles are either run-of-mine or washed product stockpiles created from the mining and preparation processes.
dozer operator	The operator of a stockpile dozer.
draw point	The place in the stockpile where material is drawn into a reclaim tunnel through chutes, vibratory feeders, valves, or ploughs. There may be several draw points in a recovery system. See Figure 6.
hazardous area classifications	Hazardous areas are classified into zones to facilitate the selection of the correct electrical apparatus and to ensure that the electrical design and installation meets the specified requirements to be used in different areas. The zone classification is based on the likelihood and the duration of an explosive atmosphere. The zone classification for gases is divided into three zones, namely Zone 0, Zone 1, and Zone 2 and for dusts Zone 20, Zone 21, and Zone 22.
rat-holing	A condition where the void created above a feeder has near vertical sides from the aperture in the feeder below the draw point to the surface of the stockpile. See Figure 6.
reclaim tunnels	Tunnel in or under a stockpile used for removing product from the stockpile. See Figure 6.
rill angle	The angle of the side slope at which stockpile material resides after being tipped, discharged, or placed on a stockpile (like angle of repose).
short-term exposure limit	Means the time weighted average maximum airborne concentration of a substance calculated over a 15-minute period.
stockpile dozer	A generic term for plant which may a tracked or rubber tyred dozer used for pushing material on a stockpile.
trigger action response plan (TARP)	Graduated table of actions to be completed as defined limits are reached. Used for managing critical situations, a typical TARP document sets out a certain set of conditions (triggers) and a set of actions which mine managers and supervisors must follow when those trigger events occur. They typically include several different trigger levels, each with a set of responsibilities assigned to mine personnel to action, as necessary.

Term	Meaning
workplace exposure standard for airborne contaminants	At the time publication means: Workplace Exposure Standard for Airborne Contaminants published by SafeWork Australia. See www.safeworkaustralia.gov.au

5.2. Acronyms

Term	Meaning
HAC	hazardous area classification.
FRAS	fire resistant anti-static.
FEL	front end loader.
LEL	lower explosive limit.
PPM	parts of vapour or gas per million parts of contaminated air by volume.
RTD	remote temperature device.
STEL	short-term exposure limit.
TARP	trigger action response plan.
TWA	time weighted average.

5.3. Australian and International Standards

The following International Standards are referenced in this guide.

Standard	Title
AS 1332	Conveyor belting - textile reinforced.
AS 1333	Conveyor belting of elastomeric and steel cord construction.
AS/NZS 3000	Electrical installations (known as the Australian/New Zealand Wiring Rules).
AS/NZS 4024.1	Safety of machinery.
AS/NZS 4024.3610	Safety of machinery - Conveyors - General requirements.
AS/NZS 4024.3611	Safety of machinery - Conveyors - Belt conveyors for bulk materials handling.
AS 4606-2012	Grade S fire resistant and and anti-static requirements for conveyor belting and conveyor accessories.
AS/NZS 4804	Occupational health and safety management systems - general guidelines on principles, systems and supporting techniques.

Standard	Title
AS 5062	Fire protection for mobile and transportable equipment.
AS/NZS 60079.10.1	Explosive atmospheres - Classification of areas - Explosive gas atmospheres.
AS/NZS 60079.10.2	Explosive atmospheres - Classification of areas – Combustible dust atmospheres.
AS/NZS 60079.11	Explosive atmospheres - Equipment protection by intrinsic safety.
AS/NZS 60079.14	Explosive atmospheres - Design selection, erection, and initial inspection.

The following International Standards are referenced in this guide.

Standard	Title
ISO 3449	Earth-moving machinery - Falling-object protective structures - Laboratory tests and performance requirements.
ISO 3471	Earth-moving machinery - Rollover protective structures - Laboratory tests and performance requirements.

5.4. Additional relevant Australian Standards

The following list of relevant Australian Standards is provided for information.

Standard	Title
AS 1670.1	Fire detection, warning, control, and intercom systems - System Design, installation, and commissioning – Fire.
AS 1670.4:2018	Fire detection, warning, control, and intercom systems – System design, installation and commissioning, Part 4: Emergency warning and intercom systems.
AS 1674	Safety in welding and allied processes set.
AS/NZS 1826	Electrical equipment for explosive atmospheres - Special protection- Type of Protection 's.'
AS/NZS 1850	Portable fire extinguishers- Classification, rating, and performance testing.
AS 1851.1	Maintenance of fire protection equipment - Portable fire extinguishers.
AS 1851.2	Maintenance of fire protection equipment - Fire hose reels.
AS 1851.3	Maintenance of fire protection equipment - Automatic fire sprinkler systems.

Standard	Title
AS 1854.4	Maintenance of fire protection equipment - Fire hydrant installations.
AS 1915	Electrical equipment for explosive gas atmospheres - Battery operated vehicles.
AS 2220.1	Emergency warning and intercommunication systems in buildings - Equipment design and manufacture.
AS/NZS 2290.1:2014	Electrical equipment for coal mines – Introduction, inspection and maintenance, Part 1: For hazardous areas.
AS/NZS 2290.3:2018	Electrical equipment for coal mines – Introduction, inspection and maintenance, Part 3: Gas detecting and monitoring equipment.
AS 2380	Electrical equipment for explosive atmospheres - Explosion protection techniques - General requirements.
AS 2380.4-1994	Electrical equipment for explosive atmospheres – Explosion-protection techniques – Pressurised rooms or pressurised enclosures.
AS 2381	Electrical equipment for explosive atmospheres - Selection, installation, and maintenance – General requirements.
AS 2419.1:2017	Fire Hydrant Installations – Part 1: System Design, Installation and Commissioning.
AS 2430.1	Classification of hazardous areas – Explosive gas atmospheres.
AS 2444	Portable fire extinguishers and fire blankets – Selection and location.
AS/NZS 2865	Safe working in a confined space.
AS 2941	Fixed fire protection installations – Pumpset systems.
AS 5062	Fire prevention and protection for mobile and transportable equipment.
AS/NZS 3800:2020	Electrical equipment for explosive atmospheres – Repair and overhaul.
AS/NZS60079.1:2015	Explosive atmospheres – Part 1: Equipment protection by flameproof enclosures “d”.
AS/NZS 60079.7:2016	Explosive atmospheres – Part 7: Equipment protection by increased safety “e”.
AS/NZS 60079.15:2020	Explosive atmospheres, Part 15: Equipment protection by type of protection “n”.

Standard	Title
AS/NZS 60079.18:2016	Explosive Atmospheres, Part 18: Equipment protection by encapsulation “m”.
AS 60529-2004	Degrees of protection provided by enclosures (IP Code).
AS/NZS 61241.0:2005	Electrical apparatus for use in the presence of combustible dust – General requirements.
AS/NZS 61779:1:2020	Electrical apparatus for the detection and measurement of flammable gases – General requirements and test methods.

Appendix A – Examples of incidents

NSW GOVERNMENT | Trade & Investment

SAFETY ALERT

Stockpile dozer lodged in reclaim valve

INCIDENT

A dozer tipped into a reclaim valve when the operator misjudged the valve location. The operator was unable to sight the valve location due to the steepness and height of coal left near the valve.

The operator loaded a full blade of coal at the bottom of the ramp and pushed to the top maintaining a “curl” of coal on the blade. After reaching the push point he was still unaware of the valve location and the dozer slumped left and forward into the valve.

CIRCUMSTANCES

The incident occurred at approx 6:40pm, in wet weather. The operator had commenced working on the stockpile at shift change-over and this was his first push of the shift.

Visibility was impacted by environmental conditions but the operator was confident he could complete the task. A train was partly loaded at the time of the incident.

ABN 51 734 124 190
www.dpi.nsw.gov.au/minesafety

Mine Safety Report No: SA11-09
File No:08/4246
Comet ID: 317597819001
Prepared by: Tim Martin
Phone: 02 6571 8788
Date Created: 8 Aug 2011

INVESTIGATION

A full investigation is yet to be completed but preliminary findings show:

- There were insufficient visual cues for the operator to determine the location of the valve at the time of the incident. This was compounded by the condition of the stockpile at shift changeover.
- The operator had not been given sufficient time to familiarise himself with the condition of the stockpile and the stockpile procedures.
- The valve was left open during the shift change, contrary to stockpile operating procedures.
- The dozer was meant to have a tilt switch fitted to allow for engine shut-off independent of the operator, however, a tilt switch wasn't installed at the time of the incident.

RECOMMENDATIONS

- Dozer operators should have a positive visual of the void before working near the valve. Training and competence of dozer operators should include a familiarisation period for coal stockpile operations.
- Review dozer operating procedures on stockpiles, with particular focus on specific controls for dozer positioning in relation to valves/feeders. Draft MDG28 *Safety requirements – Reclaim tunnels and coal stockpiles* would assist in this review.
- Review the protocols for starting and stopping valves on live stockpiles.
- Review and implement additional devices to determine the location of valves or other high risk areas on stockpiles in relation to dozer position.
- Ensure the parameters of any GPS system are understood and designed to give useful and accurate information to the operator. The system should be set to alarm if the dozer is in a dangerous position to tell the operator to stop the machine and reverse away.
- Install tilt switches on all stockpile dozers to shut down the engine independent of the dozer operator. Develop systems and procedures to ensure tilt switches are installed and maintained.
- Review the potential for dozer engulfment. If the stockpile poses an engulfment risk to the dozer operator then the cab of the dozer should be sufficiently strengthened to resist burial pressures.

Page 3

This type of incident has occurred on three separate occasions in recent times in NSW coalfields. All operations should consider the hierarchy of controls for elimination of the hazard. The use of automation or remote control should be conscientiously and actively investigated. The potential for other engineering solutions to remove human interaction as far as possible should also be investigated.

NOTE: Please ensure all relevant people in your organisation receive a copy of this Safety Alert, and are informed of its content and recommendations. This Safety Alert should be processed in a systematic manner through the mine's information and communication process. It should also be placed on the mine's notice board.

Signed

Rob Regan
DIRECTOR
MINE SAFETY OPERATIONS BRANCH
TRADE & INVESTMENT

View more safety alerts at www.dpi.nsw.gov.au/minerals/safety/safety-alerts. If you would like to receive safety alerts by email, enter your contact details at www.dpi.nsw.gov.au/minerals/safety/signup

Coal reclaim tunnel incident, Queensland 2000

https://www.dnrme.qld.gov.au/business/mining/safety-and-health/alerts-and-bulletins/mines-safety/coal-reclaim-tunnel-incident

Stockpile fatality, Illinois, 2017. US Department of Labor Investigation Report.

https://www.msha.gov/data-reports/fatality-reports/2017/fatality-4-june-08-2017/final-report