



**Industry &
Investment**

Investigation Report

Injury resulting in death involving a mobile
bolter at the Myuna Colliery on

24 July 2008

Report prepared for the Director General of the
Department of Industry and Investment by the
Investigation Unit, Thornton

Mine Safety Investigation Unit

Title: Investigation Report,

Injury resulting in death involving a mobile bolter at the Myuna Colliery
on 24 July 2008

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The information contained in this publication is based on knowledge and understanding at the time of writing. However, because of advances in knowledge, users are reminded of the need to ensure that information on which they rely is up to date and to check the currency of the information with the appropriate officer of the Department of Industry and Investment or the user's independent advisor.

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Overview

The incident

On 24 July 2008 at about 5.30pm, Mr Darren Burgess, was operating the rib bolter (bolting rig) of a Mobile Bolter. He apparently stood a drill steel on the perforated decking that formed the work area floor after drilling a rib hole, resting the top of the drill steel on the butterfly plates. The top of the drill steel fell between the operator's control panel and rested above the rib bolter carriageway.

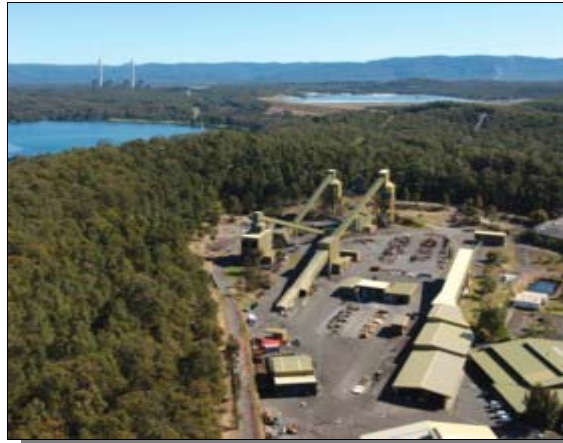
It appears the drill head of the bolter, while being retracted after pushing a bolt into the rib, caught the top of the drill steel causing it to bend and be placed under tension. The lower end of the drill steel, the drill bit, appears to have been caught in a perforation of the flooring.

The drill bit suddenly and violently released from the flooring striking Mr Burgess on the foot.

While recovering from this injury Mr Burgess had a massive heart attack on 3 September 2008 and was pronounced dead on 4 September 2008 as a result of his workplace injuries.

The mine

The mine:	Myuna Colliery
Mine location:	Wangi Point Road Wangi Wangi NSW 2267
Ultimate holding company:	Centennial Coal Company Limited
Colliery holder:	Centennial Myuna Pty Limited
Operator of coal operation:	Centennial Myuna Pty Limited
Number of employees at coal operation:	165
Production 2009:	1.5 million tonnes per annum of thermal coal



Centennial Coal's Myuna Colliery, with its office and pit top facilities close to Lake Macquarie.

(Photo sourced from Centennial Coal website at: www.centennialcoal.com.au)

Underground coal mine

The Myuna Colliery is an underground coal mine located in the Newcastle Coalfield of New South Wales. It is situated at Wangi Wangi on Lake Macquarie, close to the decommissioned Wangi Power Station, about 35km south of Newcastle.

The mine has been operating for 25 years (1985) and currently uses three continuous miner units in the board and pillar method of extraction. Coal is mined from three seams on a 3-shift per day basis. All mining production comes from first workings, due to restrictions imposed by Lake Macquarie and its foreshore.

The production units use the place changer mining system with remote controlled continuous miners and mobile multi bolters (mobile bolters).

The Myuna Colliery has coal resources exceeding 380 million tonnes, being mainly low sulphur thermal coal suitable for export or domestic markets. Current production is about 1.5 million tonnes per annum, which will expand to 2 million tonnes per annum with a new unit in the Wallarah seam. The mine employs about 165 people.

The mine is close to its major customer, Eraring Energy, which it supplies by means of a dedicated conveyor.

The employer

A major fuel supplier to the energy industry

Centennial Myuna Pty Limited is the owner, manager and nominated operator of the Myuna Colliery. The company employed Mr Burgess.

The major shareholder, and ultimate holding company, of Centennial Myuna Pty Limited is identified as Centennial Coal Company Limited.

Centennial Coal was established in 1989 and listed on the Australian Securities Exchange in 1994; Centennial is a coal mining and marketing company supplying thermal and coking coal to the domestic and export markets. The Company is a major fuel supplier to the New South Wales energy industry, fuelling approximately 46% of the State's coal-fired electricity.

Centennial sells 30 to 35% of its coal for export through ports at Newcastle and Port Kembla in NSW. Customers include power stations and steel mills in Taiwan, Japan, Korea, India, and Europe.

In September 2009 Centennial had approximately 1,700 employees.

Centennial is the largest independent coal company in Australia in terms of production. It has 9 coal mines in NSW, making it one of the largest underground coal producers in the state.

Source: www.centennialcoal.com.au

The mobile bolter

The plant:	Sandvik Mobile Bolter 4E-2A-2245-WT
	Machine length 6500mm
	Machine width 3500mm
	Machine height 2100mm
	Tramming speed 0-0.5 metre/second
	Weight 34,000kg
Equipment:	Four roof bolters: Sandvik, S2500-1650, mounted vertically
	Two rib bolters: Sandvik, S2500-1150, mounted horizontally
Manufacturer:	Sandvik Mining and Construction Redhead Pty Limited
Ultimate holding company:	Sandvik AB, Sweden

The mobile bolters were made locally

Sandvik Mining and Construction Redhead Pty Limited supplied two mobile bolters to the Myuna Colliery.

Originally, Hydramatic Engineering Pty Ltd, quoted for the design, manufacture, delivery and commissioning of one or two ARO Mobile Bolter/s on 21 November 2006. Centennial Myuna Pty Ltd initially considered sourcing a modified mobile bolter from the United States. However, the company ultimately decided to have two new bolters manufactured locally to ensure components and parts were interchangeable.

A contract for design, manufacture, supply, delivery and commissioning of two mobile bolters between Centennial Myuna Pty Limited and Hydramatic Engineering Pty Limited was entered into on 29 November 2006. Both machines were manufactured at Hydramatic's Redhead facility.

Hydramatic acquired by Sandvik

Sandvik Mining and Construction Australia acquired Hydramatic Engineering on 28 February 2007, with the company's name changed to Sandvik Mining and Construction Redhead Pty Limited on 1 March 2007.

The first Sandvik Mobile Bolter was delivered to the Myuna mine on 27 February 2008.

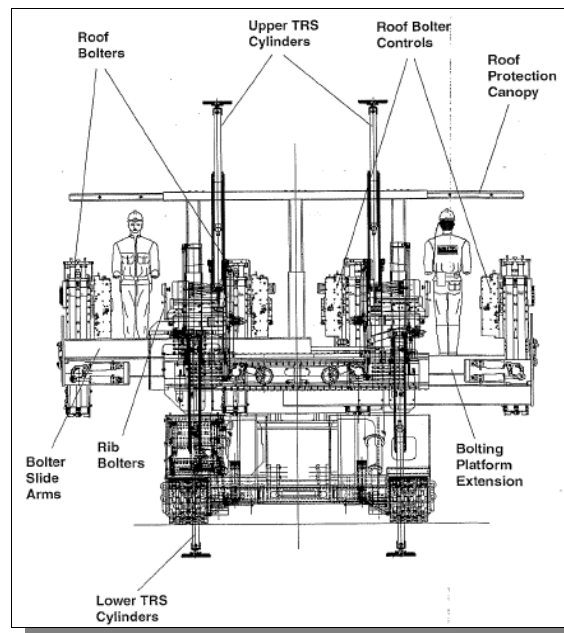
The Sandvik company - supplier of the plant

Sandvik Mining and Construction Redhead Pty Limited were the designer, manufacturer and supplier of the Mobile Bolter to the Myuna Colliery on acquisition of Hydramatic Engineering Pty Ltd.

Hydramatic Engineering developed and manufactured drilling and bolting machines under the brand ARO designed for rock reinforcement in underground mines and tunnels. The company was headquartered in Redhead, Australia and had business units in South Africa, Germany, the USA, and the United Kingdom.

Sandvik is a global high technology engineering Group, with 47,000 employees in 130 countries. Sandvik Mining and Construction, is one of three Business Areas of the Sandvik Group.

Sandvik Mining and Construction in Australia is the leading supplier of equipment, tools and services to the mining and construction industries. There are approximately 2500 employees at more than 70 locations across Australia and New Zealand.



Front view of Mobile Bolter

First mobile bolter begins operations

The underground build of the first mobile bolter was completed on 8 April 2008. Underground commissioning was carried out on 28 April 2008. The Sandvik Mobile Bolter, known at the Myuna Colliery as RB 901, commenced operation after the commissioning was completed (see photo below).



The front of the Sandvik Mobile Bolter RB901 underground at the Myuna Colliery. The temporary roof support (TRS) and extended platform on the LH of the machine (right-side photo) can be seen. These structures are to facilitate rib bolting.

Photo taken by Investigator Freeman on 11 September 2008

Features of the mobile bolter

The Mobile Bolter is a track mounted mobile bolting machine used to install ground support in both ribs and roof. The mobile bolter is designed to allow operators to carry out this work in a protective environment and safe location.

The Mobile Bolter has six drilling and bolting rigs (bolters); four roof bolting rigs mounted vertically across the front of the machine that can be used simultaneously and two rib bolting rigs, mounted horizontally on the left and right side platforms, so the machine can rib bolt while parked in the centre of the roadway. Rib bolting may also be carried out while roof bolting is underway.

The Mobile Bolter is designed to be operated by two persons with the roof and rib bolters being operated by only one person.

The Sandvik Mobile Bolter is a walk-through design, allowing operators onboard access from the rear of the machine to the large extendable bolting platform at the front of the machine. Platform access is provided via a sliding walkway assembly that elevates with the platform as the bolting boom is raised.

The design also includes a roof protection canopy to protect operators during bolting operations, and large, easily accessible consumable storage areas either side of the walkway on the top deck of the rear of the mobile bolter.

The incident

Starting work

On the day of the incident Mr Burgess started his afternoon shift at the mine at about 2.30pm. He then went underground to carry out roof and rib support operations by using the Sandvik Mobile Bolter RB901 in the 5 East Panel of the Fassifern workings at the Myuna Colliery.

Operating the mobile bolter

At about 5.30 pm, after operating the rib bolter and drilling a horizontal rib hole, he removed the 1.2m drill steel and stood it vertically against the bolt butterfly plates that were on the holder next to the rib bolter operators control panel (see photo below). After pushing the bolt into the prepared hole the drill head of the rib bolter was used to tighten the bolt nut and then was retracted back.

Drill steel falls

It appears that before or while he retracted the drill head the drill steel fell between the butterfly plates and the drill control box resting against a retractable hand railing above the drill head carriageways (see yellow round bar in second photo). When the drillhead was brought back it has pushed against the top of the drill steel placing it in tension and bending the drill steel.

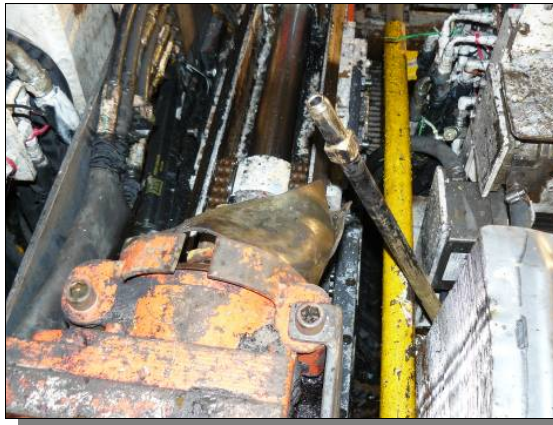
The drill bit was released from the floor plate and struck Mr Burgess on the outside of his left foot with considerable force. The drill bit cut his gumboot, lacerated his foot and fractured the 5th metatarsal.



The drill steel in the approximate position when it fell between the butterfly plates and the rib bolter control panel.

Note drill steel resting on bar installed post-incident.

Photo taken by Investigator Freeman on 11 September 2008



The top of the drill steel lying over near the rib bolter drillhead.

Photo taken by Investigator Freeman on 11 September 2008



The drill steel and drill bit in the approximate position on the metal plate floor of the mobile bolter.

Photo taken by Investigator Freeman on 11 September 2008

The deceased person

Name:	Darren Ronald Burgess
Date of Birth:	14 July 1960
Age at time of incident:	48 years
Sex:	Male
Family status:	Father of two teenage children; male and female
Occupation at time of incident:	Multiskilled mineworker afternoon shift
Mining experience	29 years in the mining industry, permanent employee at Myuna Colliery since 30 January 1979

Emergency response	Mr Burgess called for help, with the mine's emergency response being enacted. He was initially taken to the surface facilities where he received first aid treatment by the mine's first aid officer.
Injuries from the drill steel	Mr Burgess received a small laceration to his left foot with little active bleeding. It was later determined that the base of the 5th metatarsal of the left foot was fractured with the fracture line extending into the articular (joint) surface.
Transported to hospital	An ambulance arrived at the mine at about 6.55pm. Mr Burgess was taken to the Hunter New England NSW Health, Belmont District Hospital, arriving at 7.44pm. At 8.30pm he was x-rayed, and later returned to the Emergency Department of the hospital.
Initial injury treatment	On the 25 July 2008 his wound was dressed and the foot immobilised in a below the knee plaster fibreglass cast at the Belmont District Hospital. He was discharged later that day and transported home by his father to begin his recuperation.
Ongoing treatment	Mr Burgess attended his nominated treating doctor (NTD) with regard to workers compensation on 29 July 2008 and 12 August 2008, with a visit to the Orthopaedic Clinic at Belmont District Hospital on the 6 August 2008. He was scheduled to have his plaster removed at the hospital on 3 September 2008.
Died of complications from injury	However, at around 8.30am on the 3 September 2008 Mr Burgess developed chest pains. An ambulance was called by his father at 8.33am to take him Maitland Hospital. On the way to hospital at Maitland, a distance of about 15km, Mr Burgess went into cardiac-arrest. He was resuscitated. After a further four cardiac arrests and resuscitations he was stabilised and conveyed to the ICU at the John Hunter Hospital, Rankin Park, near Newcastle. After suffering acute pulmonary embolism and having support withdrawn, Mr. Burgess was declared dead at 10.45am on 4 September 2008 at the John Hunter Hospital.
Coroner and cause of death	Medical reports indicate that a massive embolus had travelled to the right atrium causing the heart attack. The Newcastle Coroner has recorded the cause of death as "pulmonary thrombo-embolism", with the antecedent cause being "trauma to the left leg".

Actions post-incident

Response by the mine

Centennial Myuna Pty Limited undertook the following remedial measures following the incident.

- An Engineering Report was commissioned on the incident by the Mine Manager. It was completed on 28 July 2008. The report recommended moving the drill steel away from the operation of the rib bolting motor frame by engineering modifications to the mobile bolters to prevent recurrence.
- The incident was discussed at toolbox talks for all shifts on 29 July 2008.

Modification to the mobile bolters

- A “bar or handle” was manufactured and fitted to prevent drill steels or bolts from falling onto the rib bolter carriageway. These were fitted to both the mobile bolters on 29 July 2008.



The bar or handle fitted at the rib bolter.

(Photo taken by Investigator Freeman on 11 September 2008)

- Manufactured and fitting of a “hook and cup” arrangement on the end rib protection shield for temporary storage of the drill steel while not in use. These were fitted to both mobile bolters on 29 July 2008.

Note: this arrangement is made to hold one drill steel only.



The “hook and cup” fitted to the rib protection shield.

(Photo taken by Investigator Freeman on 11 September 2008)

Job and safety system documents reviewed	<ul style="list-style-type: none"> • Safe operating procedure (SOP) for installing rib bolts was revised with appropriate amendments including instruction on where to place drill steels when not in use included. • Mobile Bolter operators were informed of modifications to rib bolters and amendments to the SOP by their Deputies. • Conducted ongoing equipment and machinery reviews. Other tool holders and ergonomic aids have been added to the rib bolter operator's workstation since the incident. • Review of mine's health and safety management system.
No evidence of action on machinery design	<p>At the time of writing, no undertaking of remedial measures has been identified by the investigation for the designer, manufacturer and supplier of the plant, Sandvik Mining and Construction Redhead Pty Limited.</p> <p>It is also noted that there has been no remedial measures or recognition of protection (such as guarding) of the moving and rotating components of the rib drill rigs from falling materials or preventing persons from contact by either the mine or equipment manufacturer.</p>
Actions of the Department	<p>Officers of Mine Safety Operations recorded the incident and lost time injury (LTI) in the Department's Comet database when received on 28 July 2008.</p> <p>The Investigation Unit conducted a detailed and thorough investigation into the incident that included both the manufacturer and supplier of the mobile bolter, and the coal operator and employer.</p>
Feedback to the family	<p>The Investigation Unit met with the father of Mr Burgess and provided through him feedback to the family on the investigation and its results.</p>
Feedback to Mine Safety Operations and mine manager	<p>A number of issues were drawn to the attention of Mine Safety Operations and the mine manager during the course of the investigation. These included; the guarding of rotating and moving parts and implementation of the amended safe operating procedure.</p>
Design issues raised	<p>The investigator raised design issues with the equipment manufacturer, such as; ergonomics, guarding, and foreseeable risks associated with operator behaviour.</p>
Monitoring improvements at the mine	<p>Mine safety operations officers monitored other improvement programs that included job safety analysis, toolbox talks and monitoring and review of the remedial measures undertaken by Myuna Colliery.</p>
Mine design guideline published	<p>As a result of this incident, previous bolting machine incidents, and the continued monitoring and review of the bolting and drilling incidents reported to the Department, the Chief Inspector has approved and published a mining design guideline, MDG 35.1 <i>Guideline for Bolting and Drilling Plant in Mines, Part 1: Bolting plant for strata support in underground coal mines</i>.</p>
Report to the Coroner	<p>A report was prepared for the Newcastle Coroner. The investigator and an officer of the Department's Legal Branch attended the Coronial mentions.</p>

The investigation

The Department's Authority

The Department has authority to investigate this incident as it happened at an underground coal mine.

The Department's investigator who led the investigation into the incident, Mr Mark Freeman, holds an appointment as an investigator under section 145 of the CMHSA. Investigator Freeman also holds an identification card issued under section 48 of the *Occupational Health and Safety Act 2000* (OHSA).

As a result, Investigator Freeman is authorised to exercise functions under the OHSA with respect to a coal workplace, and other premises, for the purpose of investigating any matter under the OHSA in relation to a coal workplace.

Investigator Freeman commenced the investigation on 5 September 2008.

The lines of inquiry

The investigation focussed on the design and supply of the mobile bolter, and the operation and use of the rib bolting workstation in the workplace.

Lines of inquiry included:

- mobile bolter inspection
- obtaining information from the employer, mine management and other operators
- obtaining information from the plant designer, manufacturer and supplier, company management and representatives
- examination of documents and records – with a focus on ergonomic design, the guarding of rotating and moving machinery components, operator safety, safe work arrangements and storage of bolter equipment and consumables.

Department officers inspected the mobile bolter

On 5 September 2008 the Investigator, Investigation Unit Manager and Inspector of Coal Mines met with senior management of Myuna Colliery and the Industry Check Inspector to discuss the investigation.

The Inspector of Coal Mines issued a section 89 Investigation Notice to the mine.

The investigator, along with the inspector, inspected the mobile bolter on 11 September 2008 underground at the Myuna Colliery. They were accompanied by various mine company representatives, the site check inspector and a mobile bolter operator.

During the inspection the investigator examined the mobile bolter; including the rib bolter and modifications made to the rib bolter workstation.

The investigator took photos of the mobile bolter, rib and roof bolting machines, storage systems and drill steels.

Persons gave evidence

A number of persons met with the investigator and gave information or evidence in regard to the investigation.

System documents and records

The documents and records examined during the investigation include:

- Medical records from nominated treating doctor and hospitals
- Documents relating to the Deceased from NSW Police
- Workers compensation and rehabilitation reports for the Deceased
- Incident and engineering reports from Myuna Colliery
- Myuna's safe operating procedure for installing rib bolts using the Sandvik mobile bolter
- Plant safety file, including
 - quotations, letters and agreement for supply
 - design reviews and statements
 - as built information and drawings
 - operational reviews
 - commissioning
 - operator and training manuals and assessments
- Risk assessments and compliance audits
- Extracts from the Centennial Myuna health and safety management system, including
 - electrical and mechanical engineering management plans
 - supply procedures
 - safe operating procedures for mobile bolter
 - maintenance records
- Centennial plant and equipment purchase policy and procedures.

The document review indicated that the employer had safety management systems in place at the mine at the time of the incident. The Centennial Myuna health and safety management system had, in general, regard to the safety and health of employees while at work.

Findings

Primary cause failure to identify risk	<p>The primary cause of the incident was a failure to identify risks arising from poor plant design and housekeeping, associated with ergonomic design issues and lack of appropriate guarding.</p>
Inadequate storage	<p>The mobile bolter did not have adequate storage within or near the operator's workstation for the rib bolter tools, equipment and consumables.</p> <p>Consumable storage (such as drill steels) was located at the rear of the mobile bolter in storage cassettes (pods), away from the rib bolting machine workstations.</p>
No guarding	<p>There is no physical guard to prevent contact of external objects, such as the operator himself or falling materials, with moving or rotating parts of the rib bolting machine (or roof bolting machines for that matter). Likewise, there is no guard to prevent ejection of broken drill steels or bolts.</p>
System of work, information and instruction	<p>The investigation found the system of work being used was not safe and without risk.</p> <p>Information was not provided with regard to those rib bolting activities and storage of drill steels and other materials to operators.</p> <p>While there was a safe operating procedure it did not include instructions relating to potential risks associated with poor housekeeping and the storage of drill steels when not in use.</p>
Risk realised	<p>As a result, an unsecured 1.2 metre drill steel fell from where it was being temporarily stored during the rib drilling and bolting cycle in a vertical position near the operator's control panel and onto the horizontal rib bolter drill slides or carriageways.</p> <p>When the drill head was retracted it appears that it contacted the top of the drill steel and placed it under tension and bending the drill steel. The other end of the drill steel, the drill bit, was on the floor of the mobile bolter platform and most likely caught in the floorplate holes.</p> <p>Subsequently, when the drill steel was placed under tension the drill bit at the end of the drill steel flicked out resulting in a high impact injury to Mr Burgess.</p>

Strategies to prevent recurrence

A number of bolting injuries	<p>Recently there have been two incidents (including this investigation) investigated by the Investigation Unit in which mineworkers received injuries as a result of operation of bolting machines.</p> <p>On 3 March 2008 an underground mineworker was operating a continuous miner mounted drill rig when his left arm became entangled in and around the drill steel causing severe trauma to his arm. His lower left arm was later amputated. A summary report and presentation of this investigation can be sourced at: http://www.dpi.nsw.gov.au/minerals/safety/major-investigations/investigation-reports</p>
Safe design of mobile bolters	<p>The duty to supply safe plant requires designers to design plant so that risks associated with the use of the plant are eliminated, or if this is not reasonably practicable, are then controlled. In controlling risks, the designer must ensure that the plant is designed having regard to ergonomic principles.</p> <p>Furthermore, manufacturers of plant for use at work must identify foreseeable hazards, assess the risk of any identified hazard, and eliminate it, or if this is not reasonably practicable, control any risk incorporated into the plant during manufacture.</p>
Improved design	<p>The investigation examined the role of the designer, manufacturer and supplier of the mobile bolter. This included exploring corrective actions for protection from falling materials or preventing persons from contact or entanglement with the moving and rotating components of rib bolting machines.</p>
Design strategies	<p>Original equipment manufacturers of mobile bolters and other bolting rigs should:</p> <ul style="list-style-type: none">• Improve the design of work areas and workstations with regard to operator ergonomics and human-centred activities. Equipment and consumables should be able to be stored so that operators do not have to leave the work area to access consumables and tools between the steps of the drilling and bolting activities.• Incorporate the requirements of Australian Standards, such as AS4024 <i>Safety of Machinery</i>, and guidelines such as the Department's MDG 35.1 Guideline for Bolting and Drilling Plant in Mines, Part 1: Bolting plant for strata support in underground coal mines into the design of mobile bolters and on components, such as the rib bolter. Attention must be paid to the requirements for physical guarding of rotating and moving parts. With regard to the mobile bolter, and drilling rigs, consideration must be given to hazards from falling or ejected objects.• Give due consideration to the hierarchy of risk controls and its proper application in designing risk controls for foreseeable hazards. Multiple engineered barriers should be in place to control risk and injury to persons. The competency of operators, warnings indicators, colour coding, signs, impeding devices and written instruction or procedures are no substitute for physical barriers and guarding. <p>Additional controls, such as two-handed bolting controls, must not be</p>

substituted for guarding of moving and rotating parts. Such protective devices should be in addition to, and complementary to, physical barriers and other protective measures.

- Ensure that design risk reviews must include unintended behaviour of the machine operator or reasonably foreseeable misuse of the machine, including behaviour resulting from not returning drill steels to the storage pod at the rear, or other locations, of the mobile bolter.

Duty to provide information

Designers, manufacturers and suppliers have a duty to provide, or make arrangements for the provision of, adequate information about the mobile bolter to the persons to whom it is supplied to ensure its safe use.

The person to whom the mobile bolter is supplied must provide all persons involved in its use with all available information concerning health and safety about the mobile bolter.

Refer *Occupational Health and Safety Act 2000* (section 11 and section 8) and *Occupational Health and Safety Regulations 2002* (chapter 5 and clause 144).

Review supplied plant before operation

Coal operators should conduct an assessment of supplied plant to identify further risks before the plant begins work and when the plant is first used at the mine.

This must include the monitoring and review of any safe work instructions or procedures provided by the equipment manufacturer or supplier.

Further reading

Further information

The Department, over the last decade, has received a number of notifications of underground coal mine incidents involving roof and rib bolting machines. Those incidents have caused injuries such as fractures, amputation of fingers, severe soft tissue damage, nerve damage, crush injuries, lacerations and strains. The Department has published several safety alerts and other information regarding bolter incidents:

- SA08-05 Miner's arm injured using drill rig
- SA05-05 Drill rigs and serious injuries
- Mechanical Engineer Newsflash No 21 (April 2005)
Arm entrapped in rib bolter
- SA00-25 Serious injury while roof bolting
- SA99-16 Continuous miner drill rig fatally crushes tradesman
- Significant Incident Report SIR 94/4 Operator injured by drill rig

Contact with moving or rotating plant is listed on the Department's internet site as a mechanical engineering key risk (*Mechanical engineering key risks*: <http://www.dpi.nsw.gov.au/minerals/safety/resources/mechanical/key-risks>). This should be considered when mobile bolters are designed, manufactured and used, and appropriate risk controls, in particular guarding, of rotating and moving machinery components should be incorporated.