

INVESTIGATION REPORT

# SERIOUS INJURY

Unexpected movement of Powered Roof Support  
Ulan Underground Mine

7 December 2019



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## Executive summary

### Overview of incident

At approximately 3:49pm on 7 December 2019 a contract Longwall Maintenance Fitter (**Worker A**) was working on Longwall W5 at Ulan Underground Mine when he sustained serious leg injuries due to an unexpected automatic advancement of a Powered Roof Support (**PRS**). The PRS movement caused a 1,972 kg unsecured replacement PRS leg cylinder, that was resting on top of the PRS pontoon, to move and crush the worker's foot.

Worker A was working with a shearer operator and a mine worker at the time of the incident. He had been working on the task earlier in the shift with two other contracted Longwall Maintenance Fitters (**Workers B** and **C**) but they were not present at the time of the incident.

**The work task** - The work task was to transport a replacement PRS leg cylinder to PRS43 in preparation for its installation the following day. The work task was listed on the mine's Daily Plan for 7 December 2019 but, due to poor communication of the specific work task by the Longwall Deputy and lack of task related documentation provided by the Longwall Mechanical Coordinator, the workers were unaware of the requirement to transport the replacement PRS leg cylinder to PRS43 until approximately 2:00pm.

**Contractors' first occasion undertaking the work task** - None of the contract workers had been involved in transporting a PRS leg cylinder across the longwall previously nor had they been trained in this work task. The '*Chock Leg Transport and Install Procedure*' that governed the work task was not provided to them on the day and only one of the contract workers had previously viewed the procedure.

**Shearer used to transport the new cylinder** - The shearer was used to transport the new PRS leg cylinder across the face line from PRS9 by means of towing with a carry arm attachment on the shearer. At PRS44 the shearer was stopped, the armoured face conveyor (**AFC**) ceased operation and, in turn, the PRSs remained stationary.

**PRS44 was not fully advanced to the AFC** - The shearer operator manually advanced PRS44 and lowered the PRS leg cylinder from the shearer carry arm onto the pontoon of PRS44. At this point the shearer operator believed that he had fully advanced PRS44 but, significantly in the context of the incident, PRS44 was 540mm short of being fully advanced to the AFC.

**PRS44 was not isolated** - Neither the shearer nor PRS44 was electrically or hydraulically isolated (**hereafter referred to collectively as 'isolation'**) and isolation was not otherwise discussed amongst the workers at this time.

**Worker A stood over the new cylinder located on PRS44 pontoon** - Worker A positioned his feet on either side of the PRS leg cylinder and began to secure it onto PRS44 with the assistance of a mine worker using a chain block.

**Second work task commenced by the shearer operator** - The shearer operator, who was 4m away from them at PRS46, advised the workers that he was going to commence a second work task and cut coal to PRS60 for the sole purpose of parking the shearer up for the end of the shift. At the time the shearer operator assumed, based on his belief that he had already fully advanced PRS44, that PRS44 would not advance any further as the face line automatically advanced with the movement of the shearer.

**Two workers located in the shearer 'Restricted Zone' then the 'No-Go Zone'** – The shearer operator then caused the shearer to operate. The initial movement of the shearer towards the tailgate placed the two workers in a permitted 'Restricted Zone' but, as the shearer maingate drum passed PRS44 and caused PRS44 to move, the two workers came to be located in a 'No-Go Zone'. PRS44 was not isolated to prevent the movement.

**The incident and injury** - PRS44 was 540mm short of being fully advanced to the AFC. The movement of PRS44 caused the unsecured 1972kg PRS leg cylinder to be pushed by the AFC pan line onto Worker A's foot. The PRS leg cylinder caused a traumatic crush injury to Worker A's right foot and ankle. Due to the severity of the injuries, Worker A's right leg was amputated below the knee on 23 January 2020.

## Causal factors

The direct cause of the incident:

- Unexpected movement of PRS44 towards the AFC

The following factors contributed to the incident:

- The shearer operator believed that he had fully advanced PRS44 to the AFC and that PRS44 would not advance any further after the shearer had passed.
- PRS44 was not isolated to prevent automated sequence movement when the shearer moved past.
- A second work task was commenced by moving the shearer along the face simultaneously with Worker A performing the task of chaining the new PRS leg onto PRS44 pontoon resulting in 'Restricted Zone' and 'No-Go Zone' procedures now applying to the two workers at PRS44.
- Initially Worker A and a mine worker located at PRS44 were adjacent to the shearer. When the shearer initially moved, they were in the permitted shearer 'Restricted Zone'.
- As the shearer moved towards the tailgate the maingate drum moved past PRS44 placing Worker A and the mine worker in the shearer 'No-Go Zone'.
- Workers A, B and C had no training or experience relocating PRS legs along a longwall face line.

- The Longwall Deputy was not involved in the planning or conduct of the task undertaken by Workers A, B and C.
- Workers A, B and C were not provided with any procedure or other written information in relation to the task of transporting a PRS leg cylinder across the face line.
- The relevant task step in the mine's *'Chock Leg Transport and Install Procedure'* did not identify isolation of PRS and the shearer as a control and isolation was not consistently applied as a control in practice at the mine during work tasks undertaken on or in front of PRS.

## Industry recommendations

It is recommended that mine operators:

1. in consultation with workers, systematically analyse face line tasks and identify all reasonably foreseeable acts or omissions of workers when developing risk control measures
2. consider proximity detection systems for automated roof support systems to detect worker location and to prevent movement when workers are in positions of risk in addition to considering lower order administrative controls<sup>1</sup>
3. detail all risks and risk controls associated with each step involved in transporting and storing PRS leg cylinders (and other equipment) on a longwall face in a clearly documented procedure or similar that includes the following risk control measures:
  - a. The applicable risk management process to be applied to a work task.
  - b. Hydraulic isolation (including lock and tag-out) when work is conducted on or in front of a PRS to prevent unexpected movement of PRS.
  - c. 'Restricted Zone' and 'No-Go Zone' rules when work is conducted contemporaneously with shearer operation.
4. develop and implement administrative controls to increase compliance by workers with each step involved in transporting and storing PRS leg cylinders (and other equipment) on a longwall face and verify their implementation in practice, including the following:
  - a. Information, instruction and training
  - b. Communication and consultation
  - c. Supervision and management
  - d. Periodic checking, monitoring and verification
  - e. Means of holding individuals accountable for implementation

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<sup>1</sup> Proximity detection systems for automated PRSs are a technology currently being introduced into some underground coal mines in New South Wales. Proximity detection systems are designed to identify the location of personnel, initiate alarms and stop machine movement if a person is in a position of risk.

It is recommended:

1. workers vigilantly apply administrative risk control measures such as isolation, 'Restricted Zone' and 'No-Go Zone' rules
2. shearer operators ensure that, before commencing and during shearer movement, all workers in the vicinity of a shearer are complying with 'Restricted Zone' and 'No-Go Zone' rules
3. all workers hold each other accountable for compliance with administrative risk control measures and remain attentive and responsive to visual and audible alarms.



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# 1. Purpose of the report

This report describes the mining workplace incident investigation (**the investigation**) conducted by the NSW Resources Regulator into the cause and circumstances of a serious injury sustained by a contract maintenance worker (**Worker A**) due to the unexpected movement of a PRS at Ulan Underground Mine located at Ulan NSW on 7 December 2019.

## 2. Investigation overview

### 2.1. The Regulator

The Resources Regulator (**the Regulator**) investigates major workplace incidents in the NSW mining, petroleum and extractives industries. Our role is to carry out a detailed analysis of incidents and report findings to enhance industry safety standards and give effect to our [Compliance and enforcement approach](#).

### 2.2. Legislative authority to investigate

Investigators are appointed as government officials under the *Work Health and Safety (Mines and Petroleum Sites) Act 2013* and are deemed to be inspectors for the purposes of the *Work Health and Safety Act 2011*. The Regulator has also delegated some additional functions to investigators including the power to obtain information and documents for the purposes of monitoring compliance with the WHS Act.

### 2.3. Regulator response

The incident was reported to the Regulator on 7 December 2019. The initial response was to deploy inspectors to the site to undertake an initial assessment of the incident.

On 19 December 2019 the Regulator issued an [Investigation Information Release IIR19-14](#). The information release was published to provide information concerning the incident and recommendations to the mining industry.

## 3. The incident

### 3.1. Parties involved

#### 3.1.1. Mine operator

Ulan Underground Mine (**Ulan Underground**) is operated by Ulan Coal Mines Pty Limited (**UCML**). UCML is owned by Glencore Coal Assets Australia Pty Limited, a major producer of coal that operates 16 open cut and underground mines across 14 complexes in Australia.

#### 3.1.2. Labour hire contractor

BNS Mining Pty Ltd (**BNS**) was the employer of Workers A, B and C at the time of the incident. BNS is a labour hire company which supplies trade labour to Ulan Underground as well as other mine sites. BNS commenced providing labour hire services to Ulan Underground on 27 September 2018. On the date of the incident Workers A, B and C were working at Ulan Underground.

#### 3.1.3. Injured person

Worker A was 46 years of age at the time of the incident. He commenced employment with BNS as a Longwall Maintenance Fitter on 5 September 2019 and began working at Ulan Underground on 9 October 2019.

Worker A had approximately 17 years of experience working as a fitter in underground mining environments that largely involved conducting longwall relocation work and weekend maintenance work. Prior to the date of the incident he had not previously conducted the task that resulted in his injury.

### 3.2. The mine

Ulan Underground, Ulan West Underground mine, the Open Cut mine and land holdings including the Bobadeen Irrigation Scheme are collectively referred to as the Ulan Coal Complex (**UCC**). The UCC is located in New South Wales approximately 1.5 kilometres from Ulan Village, within the Mid-Western Regional Council Local Government Area. The 13,000-hectare project area is approximately 38 kilometres north-north-east of Mudgee and 19 kilometres north-east of Gulgong. The UCC includes mining leases CCL 741, MPL 315, ML 1341, ML1365, ML 1366, ML 1467, ML 1468, ML 1511, ML 1554, ML 1656, ML1754, EL 5573, EL 7542 and EL 8687.

The incident involving Worker A occurred at Ulan Underground on Longwall W5 (**LWW5**) which is located within mining lease ML1468. UCML is the leaseholder for ML1468. LWW5 commenced extraction on 18 December 2018.

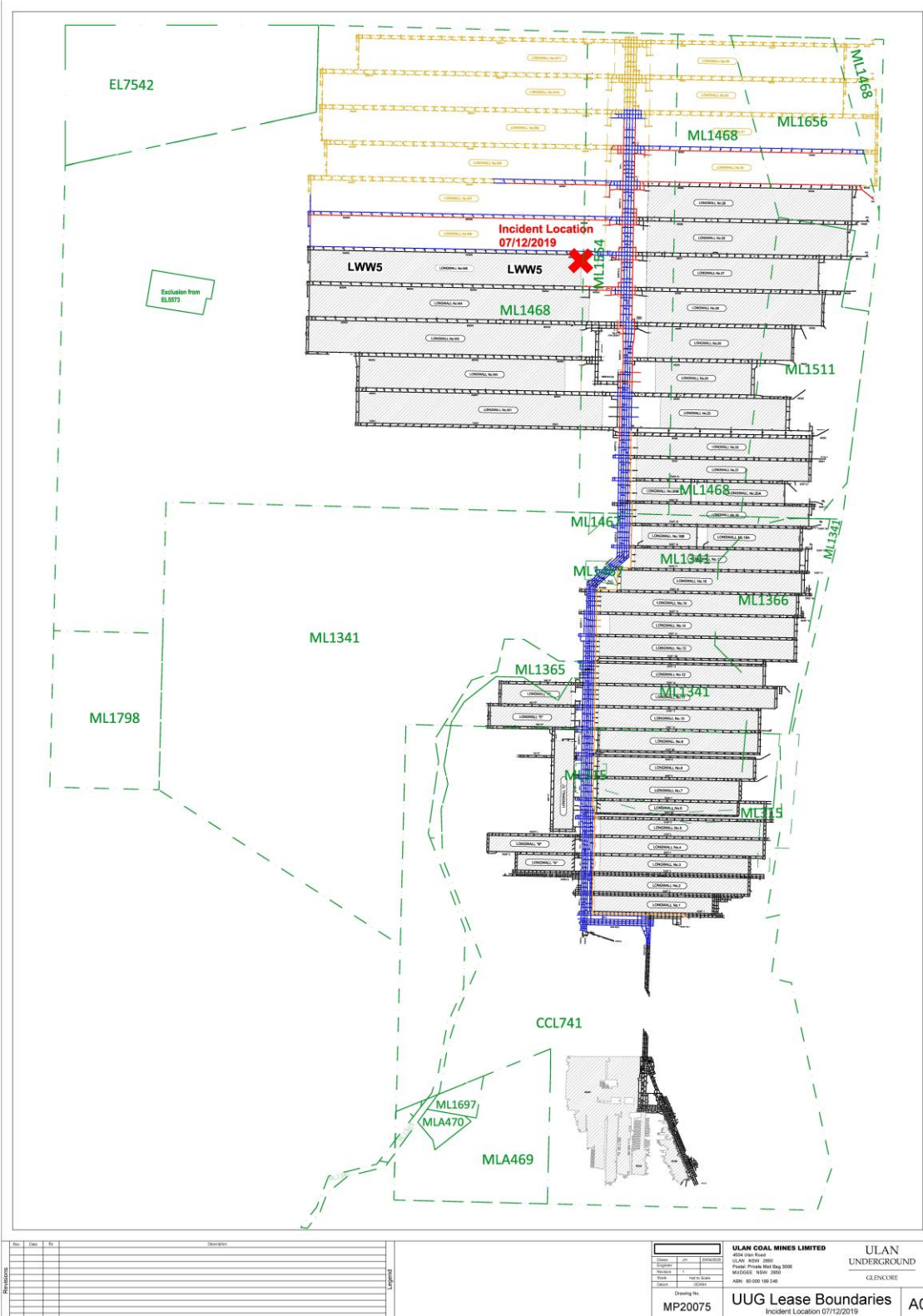
### **3.3. Mining method**

Ulan Underground utilises the longwall retreat method of mining to extract coal from the Ulan seam.

### **3.4. Incident location**

The incident occurred within mining lease ML1468. The following figure identifies the mining lease boundaries of Ulan Underground and the approximate incident location.

Figure 1 Ulan mining leases and incident location





## 3.5. Shearer operation

### 3.5.1.1. Shearer operation

The shearer is utilised to extract coal from a mining block where it operates to move along the AFC, cutting the coal seam away and loading the cut coal onto the AFC.

As the coal is extracted the longwall face is supported with hydraulically operated PRSs. The function of each PRS is to provide a safe working environment by supporting the roof as coal is extracted as well as advancing the longwall equipment. Ulan Underground's LWW5 face is 400m wide with the hydraulic support system installed consisting of 197 PRSs.

When required, the shearer is utilised to transport equipment across the longwall via attachment of a carry arm and, on the date of the incident, the shearer with attached carry arm was used to transport the PRS leg cylinder across LWW5.

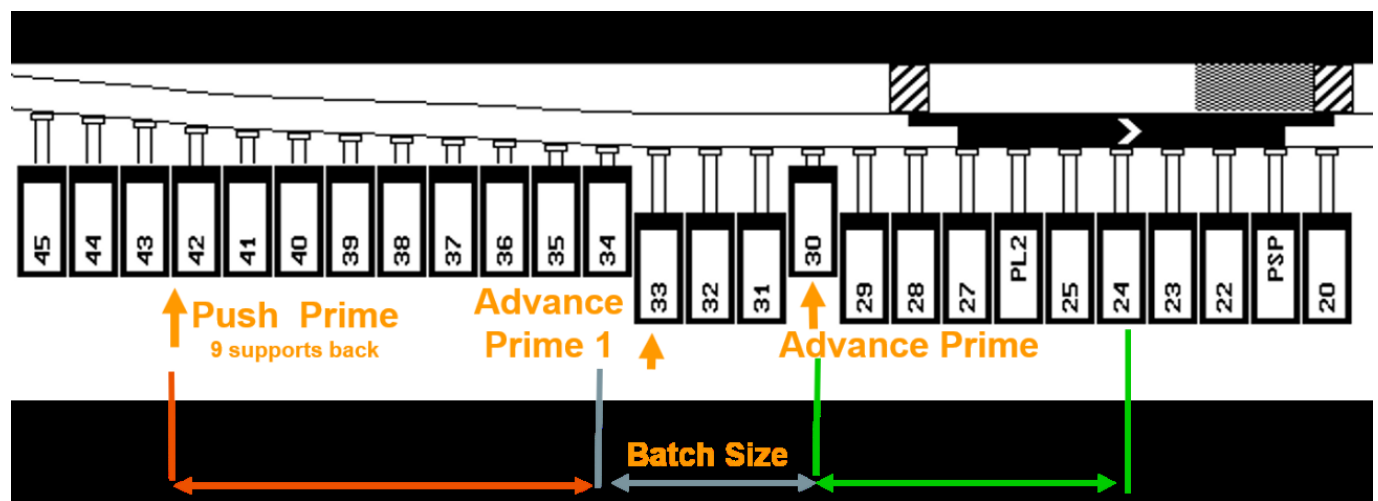
*Figure 2 Stock photograph of a shearer mining a longwall*

*Note: the equipment pictured varies from the equipment used at Ulan Underground*



The shearer control and monitoring systems at Ulan Underground allow varying degrees of automation for shearer operations, with two modes of operation available when using the Shearer Initiation Control. Normally, the PRS will automatically advance in a sequential pattern following the movement of the shearer. When the shearer moves quickly multiple support advance is systematically initiated during which the advance prime will jump ahead a few supports and then a multiple advance will be activated. The batch area of supports will then advance one at a time in that area.

Figure 3 Longwall operating in multiple support advance mode



## 3.6. The incident

### 3.6.1. Pre-incident

Workers A, B and C were rostered to work the weekend shift at Ulan Underground from Friday 6 December to Sunday 8 December 2019.

#### 6 December 2019

Workers B and C worked the shift from 6:00am to 6:00pm on Friday 6 December 2019 as scheduled. However, due to a flight delay, Worker A was unable to work as planned on 6 December 2019. During the shift on 6 December 2019, Worker B had a discussion with the Longwall Mechanical Coordinator about replacing a powered roof support (PRS) leg cylinder on LWW5. The discussion with the Longwall Mechanical Coordinator was brief and Worker B thought, following the discussion, that a PRS leg was to be replaced at PRS122.

The replacement PRS leg cylinder was originally scheduled to be transported into position on LWW5 by the Friday afternoon shift on 6 December 2019 but, due to a fan outage on that date, the transport of the PRS leg cylinder was postponed to Saturday 7 December 2019.



**7 December 2019**

Upon commencement of their shift on 7 December 2019 at 7:00am Workers A, B and C were not provided the Daily Plan listing their work tasks for the weekend despite a copy usually being left for them by the Longwall Mechanical Coordinator. Accordingly, the work task requiring transport of a PRS leg cylinder to PRS43, that was listed on the Daily Plan for 7 December 2019, was not known to Workers A, B and C at the commencement of their shift as it was not otherwise communicated to them.

The task of transporting a PRS leg cylinder to PRS43 was mentioned during the supervisors' meeting involving the Undermanager, the Longwall Deputy and other Deputies before the start of the shift, as all tasks listed on the Daily Plan are discussed during that meeting.

However, the requirement to transport a PRS leg cylinder to PRS43 was not mentioned during either the pre-start briefing of the entire crew or the general communication (**G-COM**) briefing of the underground workforce because the Longwall Deputy was focused on flooding issues on the longwall.

When Worker C asked the Longwall Deputy about the Daily Plan he was told only "full production". As a result of the Longwall Deputy's instruction Workers A, B and C were unaware of the requirement to transport a PRS leg cylinder to PRS43 for much of their shift on 7 December 2019.

Workers A, B and C first became aware that a PRS leg cylinder was required to be transported across the longwall when Worker B walked the face line at about 1:30pm or 2:00pm and noticed there was no PRS leg cylinder positioned for a scheduled PRS leg change the following day.

Worker C then telephoned the Longwall Mechanical Coordinator to advise him there was no PRS leg cylinder currently located on the face. During this conversation the Longwall Mechanical Coordinator advised that a replacement PRS leg cylinder was required to be transported to PRS43.

Worker B used the longwall radio communication system (**DAC**) to contact the Longwall Deputy who confirmed that he was aware of the requirement to transport the PRS leg cylinder and that it was listed on the Daily Plan. A discussion was then held at the maingate of LWW5, involving Workers A, B and C together with the shearer operator and two mine workers, regarding transportation of the PRS leg cylinder to PRS43.

Pre-task risk assessments using the UCML Stop Look Assess Manage technique (**SLAMs**) were completed by Workers A, B and C together with the shearer operator. It is unknown whether the other two mine workers also completed SLAMs.

Neither Worker A, B nor C had been involved in transporting a PRS leg cylinder across the longwall previously at Ulan Underground. Workers A, B and C were not provided the '*Chock Leg Transport and Install Procedure*' for the task to be completed on that shift. Worker B was the only Contract Maintenance Fitter who had previously sighted the procedure.

### 3.6.2. The incident

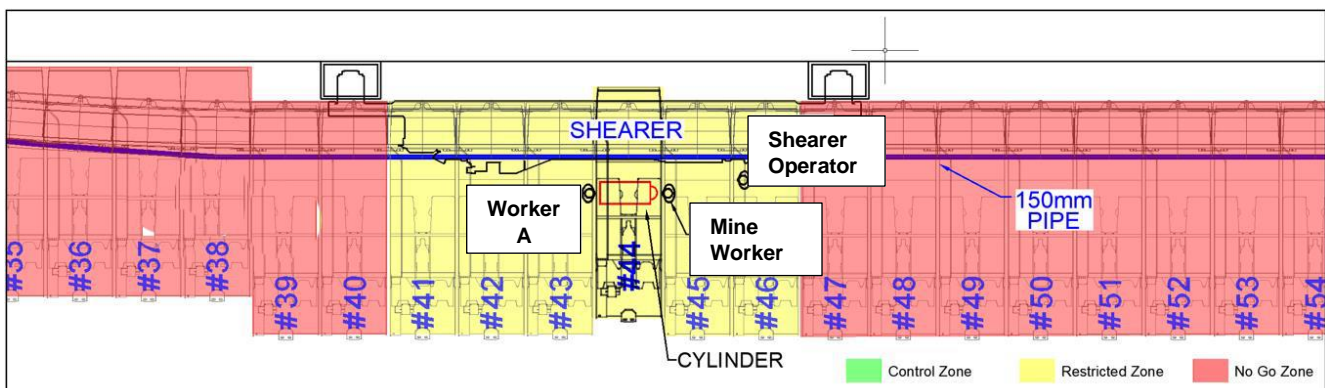
Time to last coal cut was scheduled for 3:00pm on 7 December 2019. At that time the shearer was in the maingate where several workers assisted in attaching a carry arm to it. The carry arm was to be used to tow the replacement PRS leg cylinder to PRS44 where it would be secured in readiness to replace the leg at PRS43 the following day. To begin towing the shearer was positioned at PRS9, the face automation was turned off and the PRS leg cylinder was lifted using a chain block. After the face was restarted, the shearer was then utilised to tow the PRS leg cylinder towards the tailgate whilst tramming at half speed, with the shearer operator operating the shearer and Worker A walking alongside to ensure the PRS leg cylinder did not catch on anything during towing.

Upon arrival at PRS44, the shearer was stopped and the face automation turned off. The shearer operator manually advanced PRS44 in order to position it to lower the PRS leg cylinder from the shearer carry arm. At that time the shearer operator believed PRS44 to be fully advanced by 1140mm when it in fact was later determined to have been advanced only 600mm.

At this time neither the shearer nor PRS44 was isolated and isolation was not discussed amongst the workers.

The PRS leg cylinder was lowered from the shearer carry arm into a horizontal resting position across the pontoon of PRS44 where Worker A began to secure it onto PRS44 using a chain block. At this time a mine worker arrived at PRS44 and assisted with securing the PRS leg cylinder. Worker A was positioned on the maingate side of the PRS leg cylinder and the mine worker was positioned on the tailgate side, with both individuals straddling the PRS leg cylinder on the pontoon of PRS44.

Figure 4 Position of workers in relation to longwall equipment immediately prior to the incident



As Worker A and the mine worker continued to secure the PRS leg cylinder, the shearer operator informed them he was going to commence a second task and cut coal with the shearer to PRS60. The purpose of this second task was to park up the shearer at PRS60 as coal production had finished for the shift.

Both the shearer operator and Worker A assumed that PRS44 had already been fully advanced manually by the shearer operator and, therefore, would not move when the surrounding PRSs began automatically advancing with the movement of the shearer towards the tailgate.

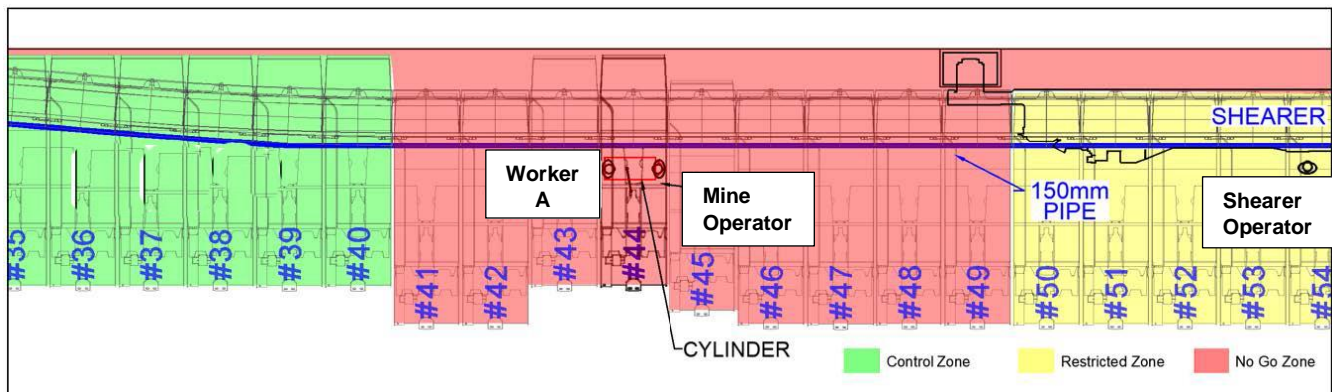
The shearer operator, who was located about 4m from Worker A, commenced to move the shearer towards the tailgate while *'keeping an eye'* on Worker A and the mine worker.

The shearer maingate drum was initially located at PRS40. Worker A and the mine worker were located at PRS44.

Audible and visual alarms located on each PRS activated as the PRS advanced towards the AFC following the movement of the shearer.

The initial movement of the shearer placed Worker A and the mine worker in a permitted location called the 'Restricted Zone' (Refer to Figure 4- Yellow coloured zone).

Figure 5 Position of workers in relation to longwall equipment at the time of the incident



The shearer continued to move a distance of four PRSs (about 8m) towards the tailgate. As the shearer maingate drum passed PRS44, Worker A and the mine worker were now located in the shearer 'No-Go Zone' which is located between the last advanced PRS and the trailing drum of the shearer (Refer to Figure 5- Red coloured zone).

The shearer continued to move another five PRSs (about 10m) toward the tailgate when the incident occurred.

The shearer had moved a total of nine PRS (about 18m) towards the tailgate.

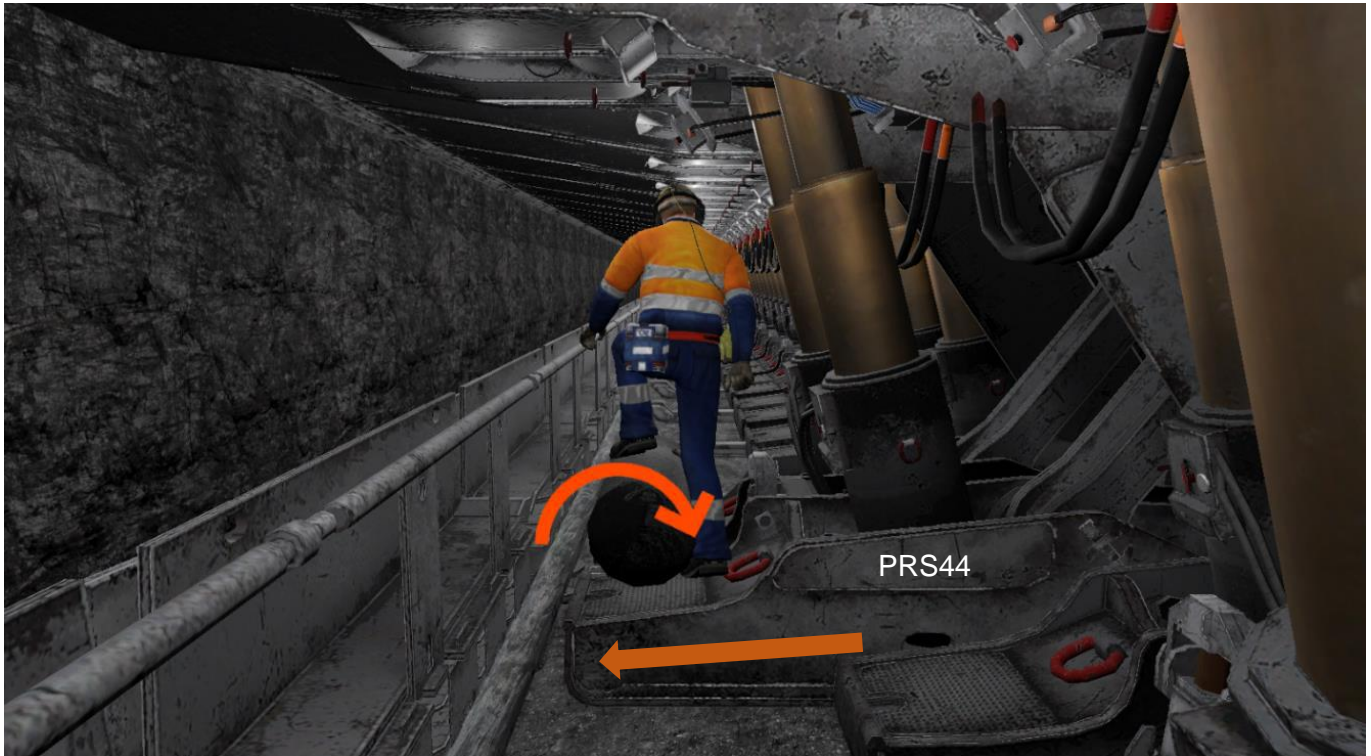
At the time of the incident, the shearer maingate drum was located at PRS49 and the shearer operator was located at PRS54 (Figure 5). The shearer operator was 10 PRSs (about 20m) away from the two workers located at PRS44.

The shearer operator noticed that PRS44 lowered as he continued to operate the shearer which caused him surprise as, thinking that it was it was fully advanced, he did not expect PRS44 to move.

PRS44 was in fact 540mm short of full advancement and moved towards the face as the shearer moved towards the tailgate. In doing so PRS44 pushed the unsecured PRS leg cylinder into a water pipe attached to the AFC pan line before it rolled onto Worker A's foot.

The PRS leg cylinder, weighing 1972 kg, caused a traumatic crush injury to Worker A's right foot and ankle.

Figure 6 VR Still Animation showing Worker A's positioning relative to the replacement PRS leg cylinder on PRS44 pontoon with arrows indicating movement of PRS44 and PRS leg cylinder (respectively)



The shearer operator stopped the shearer at which time he, the mine worker and Worker C freed Worker A's foot by pushing the pan line out which caused the PRS leg cylinder to roll away from Worker A.

Worker A was provided first aid at the scene before being transported to the surface and then to hospital for treatment.

The incident scene was preserved with the mine operator notifying the Regulator.



Figure 7 Photograph of PRS leg cylinder on pontoon of PRS44 following the incident, facing tailgate



Figure 8 Photograph of PRS leg cylinder on pontoon of PRS44 following the incident, facing maingate

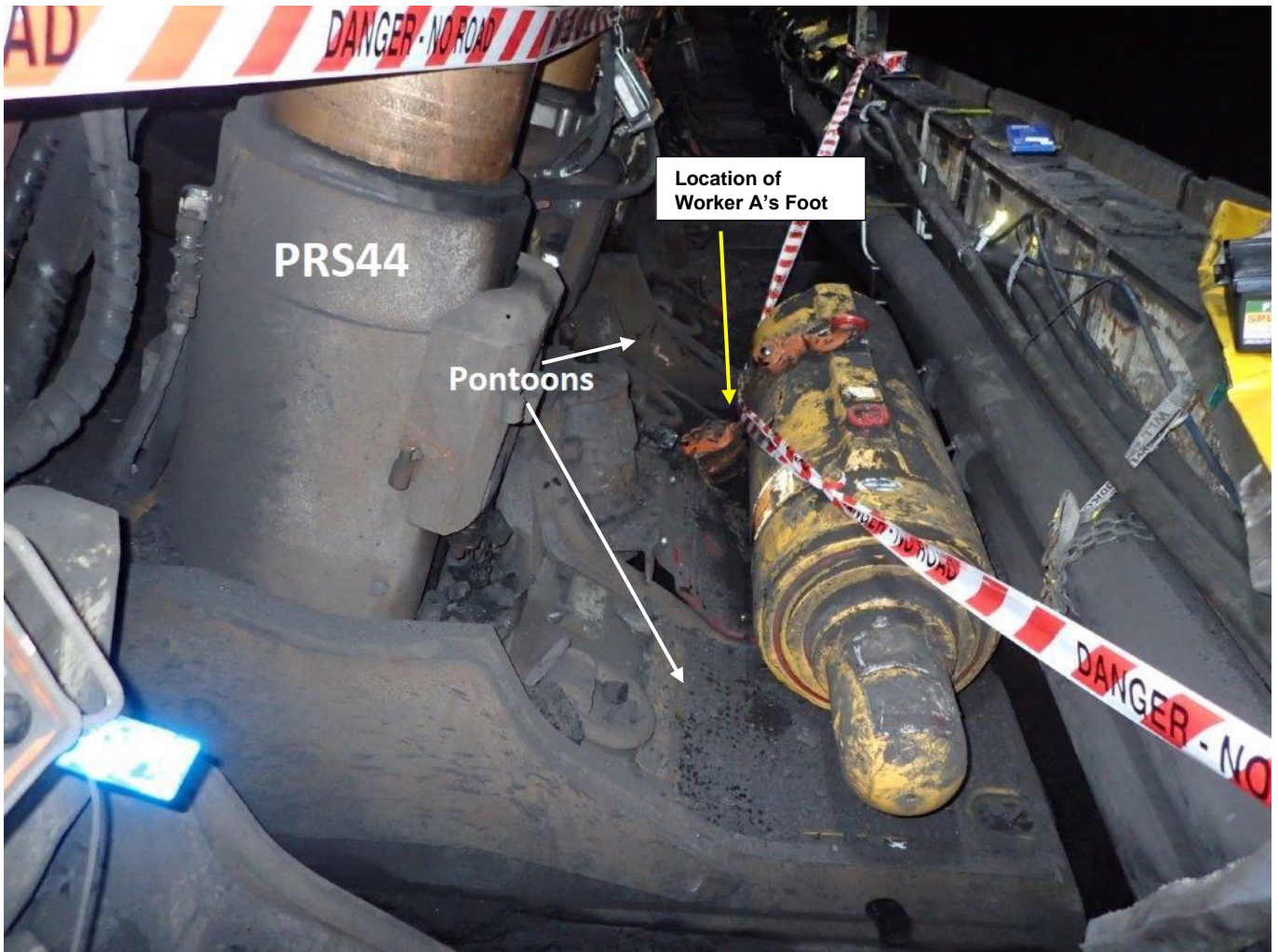




Figure 9 Photograph of PRS leg cylinder on pontoon of PRS44 following the incident



## 4. The investigation

The investigation examined the incident including the factors leading up to it and the cause of it together with the actions of workers (both employees and contractors) and UCML (the mine operator).

## 5. Investigation findings

### 5.1. Overview

The investigation established that UCML contributed to the cause of the incident by failing to:

- provide adequate information, instruction and training in relation to transporting PRS leg cylinders
- provide adequate supervision over the task of transporting PRS leg cylinders and identify clear lines of responsibility of workers. There was poor communication between task coordinators, the Longwall Deputy and workers in relation to the specific task and no supervision afforded by the Longwall Deputy over the task
- comply with its own policy in relation to monitoring of Worker A who was considered an inexperienced underground operator under the policy requiring closer (direct) oversight and supervision by a 'mentor' where necessary
- adequately implement a safe system of work in relation to the transport of PRS leg cylinders:
  - There was an ill-disciplined approach to implementation in practice of the risk assessment process directed toward the identification of hazards and risk control measures.
  - There was otherwise an ill-disciplined approach to the implementation of isolation as a risk control measure, including that the procedure which governed the transport of PRS leg cylinders did not specify isolation of PRSs and / or the shearer as a risk control.
- adequately implement a number of documented processes and procedures including work plans, procedures and risk assessment.

The investigation established that acts and / or omissions of workers contributed to the cause of the incident in that they failed to:

- identify and control the risk of unexpected movement of PRS44 but, instead, relied upon visual assessment of manual advancement of PRS44 as a control measure
- isolate and confirm isolation of PRS44

- ensure that the shearer remained stationary whilst work was being conducted on the PRS pontoon or, alternatively, that workers moved to an area of safety before the shearer recommenced operation
- abide by 'No-Go Zone' rules designed to prevent workers from being in the vicinity of PRSs when they moved
- respond to audible and visual alarms that indicated activation of a PRS.

The shearer operator commenced a second work task, involving movement of the shearer, in parallel with the completion of the PRS leg storage task by the two workers.

The initial movement of the shearer placed the two workers in the permitted shearer 'Restricted Zone' in circumstances where the shearer operator was fully aware that the two workers were located at PRS44.

As the shearer's trailing drum passed PRS44 the two workers came to be located in the shearer 'No-Go Zone' with the shearer operator still aware that the two workers were located at PRS44.

The shearer operator believed that he had earlier fully advanced PRS44 to the AFC and that PRS44 would not advance any further after the shearer passed.

## 5.2. Identified hazards

Ulan Underground's *Chock Leg Transport and Install Procedure* identified the major hazards generally involved in transporting and installing a PRS leg cylinder as unexpected movement, pinch points, moving machines and personnel interaction.

The hazards listed for the specific procedural step undertaken by the workers at the time of the incident included pinch points, stored energy, manual handling and equipment damage but did not refer to risks arising from face automation.

## 5.3. Risk to workers

The workers were at risk of crush or other injury arising from unexpected movement of an automatically advancing PRS.

## 5.4. Safety Management System – relevant controls

UCML had established a safety management system (SMS) pursuant to Clause 13(1) of the *Work Health and Safety (Mines and Petroleum Sites) Regulations 2014*. The SMS integrates documented plans, policies and procedures that are, subject to their implementation, directed toward the protection of

workers and other persons against harm to their health, safety and welfare through the elimination or minimisation of risks.

The SMS includes policies and procedures which detail Ulan Underground's Training and Competency Management System, Supervision Arrangements and Guidelines for Risk Management Tools.

## 5.4.1. Procedures to control hazards

### 5.4.1.1. Risk management

Prior to conducting the task, Workers A, B and C and the shearer operator each completed a documented personal risk assessment known as SLAM. The SLAM technique is used to remind workers to stop work if they think their health and safety is at risk. The risks and controls recorded in SLAMs completed by workers on the date of the incident are unknown as Ulan Underground was unable to locate any of them following the incident.

Ulan Underground's *Plan for Risk Management* provides that risks associated with all business areas of the mine, including risks arising from planned and unexpected changes, will be identified, analysed, evaluated and treated as appropriate. If a task is considered a routine task in a normal environment workers are required to complete a SLAM (not requiring supervisor involvement and approval) but if a task is considered a non-routine task in a normal environment, or a routine task in an abnormal environment, workers are required to complete a Job Safety Analysis (JSA) (requiring supervisor involvement and approval).

In the context of the work being undertaken on the date of the incident Ulan Underground's senior management considered that workers should have developed a JSA, requiring involvement and approval by the supervisor, but Ulan Underground supervisors were less certain with some considering that a SLAM was sufficient and others considering that a JSA was required.

Preparation of a JSA involves consideration of the task being analysed (including training, skills and equipment) and separation of the task into basic steps using the JSA Form. Hazards associated with each step are identified and methods for elimination or control of those hazards are identified and documented. The team then reviews and signs off the JSA acknowledging they understand the hazards and controls prior to undertaking work. Significantly, unlike a SLAM, the supervisor is involved in the preparation of a JSA resulting in visibility of risk controls selected by workers.

## 5.4.2. Transport of PRS leg cylinders

Ulan Underground's *Chock Leg Transport and Install Procedure* lists steps required for the transport and installation of PRS leg cylinders. In relation to the transportation of a PRS leg cylinder there are six steps listed with the final step reading "When the shearer reaches the required area lower the chock leg ram

onto the chock toes using lifting gear and retain to support.” This is the procedural step of the work task being undertaken at the time of the incident.

The controls listed in relation to that specific procedural step include correct lifting pulling technique, competent and trained personnel, correct rated lifting gear and ‘No-Go Zones’. Isolation is not listed as a recommended control at this specific procedural step.

### 5.4.3. Isolation

Ulan Underground’s *Hydraulic Isolation – EX Bulga Longwall Roof Supports Procedure* prescribes steps for the safe isolation and restoration of the internal hydraulics on PRSs. The document emphasises that it should be used in conjunction with site specific risk assessments such as a Take 5 or JSA.

The procedure identifies specific risks and controls relating to hydraulic isolation of PRS, however, the procedure does not specify in which situations PRS should be isolated.

The *Longwall Safety Overview, Ulan Underground TRN - Learner Guide* details a number of controls located on the PRS mimic control unit designed to stop PRS movement. These controls include an emergency stop, a pause function and ‘electrical isolation’. The black button on the PRSs mimic control panel is termed ‘electrical isolation’ and would prevent the PRS from moving as a result of face automation.

### 5.4.4. ‘No-Go Zones’

Glencore Coal Assets Australia SafeCoal Rules were introduced at Ulan Underground as part of the SafeCoal safety intervention program implemented with the intent to prevent fatalities, serious injuries and High Potential Risk Incidents. SafeCoal Rule 4 states: “Never enter ‘No-Go Zones’.”

‘No-Go Zones’ include operating zones around equipment, areas of unsupported roof or those under a suspended load, areas signposted as ‘no road’ or those in close proximity to high or low walls, confined spaces, areas around loaded shots or other ‘No-Go Zones’ identified by legislation or the site SMS.

Key behaviour supporting SafeCoal Rule 4 includes putting ‘No-Go Zones’ in place to protect against personal injury or death.

Zones on the longwall, depending upon the prevailing circumstances, are termed ‘Restricted’, ‘Control’ and ‘No-Go’ for equipment operation during the normal cutting sequence of the longwall.

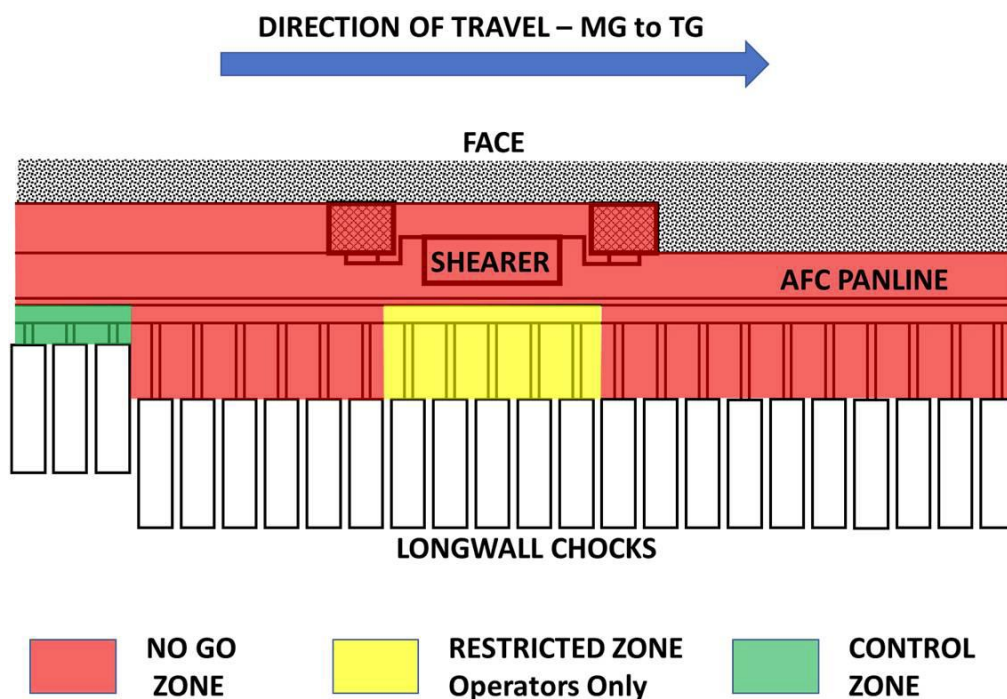
‘No-Go Zones’ typically contain a number of pinch / crush points, especially during operations involving machine movement. Throughout normal operations there are two broad areas of safety zones:

1. ‘Restricted Zones’ in which the operator in control of the relevant equipment will grant permission for personnel to have access; or



2. 'No-Go Zones' where access is prohibited. A 'No-Go Zone' includes an area on or around a longwall face where there is a high risk to a person of being struck by any part of the longwall equipment if it is operated or moved to its limit either deliberately or unexpectedly.
  - a. Significantly, in the context of the incident, the area between the last advanced PRS and the trailing drum of the shearer is a 'No-Go Zone' whilst the shearer is operational. The shearer operator has responsibility for ensuring this area is clear of personnel prior to starting the shearer.

Figure 10 Longwall face access zones with shearer cutting to tailgate



## 5.5. Ineffective controls

### 5.5.1. Application of risk management processes – SLAM or JSA

There was an inconsistent understanding between Ulan Underground’s senior management, on the one hand, and deputies, statutory position holders and workers, on the other hand, as to whether a SLAM or JSA was required to be developed for the work task undertaken at the time of the incident. Senior mine management considered that a JSA was required whereas deputies, statutory position holders and workers generally considered that a SLAM was appropriate.

The inconsistency in understanding on this matter takes on a level of significance, particularly in the context of the prevailing ill-disciplined approach to applying isolation and adhering to 'No-Go Zone' rules as risk controls for the relevant work task, as it resulted in lack of clear direction to workers as to what risk management process was required to be applied. This, in turn, manifested itself in a decision by workers to develop a SLAM which meant that a supervisor (the Longwall Deputy) was not involved in the process and the opportunity to identify and rectify the absence of isolation and adherence to 'No-Go Zone' rules as risk control measures missed. In contrast, identification that a JSA was required would have necessitated the supervisor's (the Longwall Deputy) involvement and approval thereby providing an opportunity to identify and rectify the absence of isolation and adherence to 'No-Go Zone' rules as risk controls.

### 5.5.2. Information, instruction, training and experience

Ulan Underground provides information, instruction and training to workers in longwall safety, by reference to the *Longwall Safety Overview*, *Ulan Underground TRN - Learner Guide (the Learner Guide)*, during their induction to site.

This *Learner Guide* sets out in detail restrictions surrounding 'Restricted Zones' and 'No-Go Zones', particularly in relation to movement of PRSs and the shearer. Workers also undertake a course assessment at the end of the training to verify their understanding of the zones. Specific questions in the 'Learner Guide' assessment are directed toward the workers' awareness of safe access zones on the longwall face including:

- Never ride on an advancing PRS.
- A crush zone is present between the back plate of the AFC and the toe of the advancing PRS.
- The location of 'Restricted Zones' and 'No-Go Zones' in relation to movement of the shearer.

In relation to the task of transporting and securing a PRS leg cylinder on the longwall, workers were generally provided informal on-the-job training with other more experienced workers and were expected to refer to the *Chock Leg Transport and Install Procedure* for task instructions.

The following deficiencies in the provision of information, instruction and training concerning transport of the PRS leg cylinder to PRS43 existed as at the date of the incident:

- Workers had been provided training in the *Learner Guide* which included the application of 'No-Go Zones' in the context of PRS and shearer movement, however, the guide did not reference isolation as a control measure when working on or in front of PRS.
- Workers involved in the work task had not been provided adequate information, instruction or training in the *Chock Leg Transport and Install Procedure* nor had any signed the procedure to verify an understanding as required prior to the date of the incident.



- Workers involved in the work task had not otherwise been provided any information or instruction, verbal or written, about the task on the date of the incident:
  - It was not discussed during either the pre-start briefing of the entire crew or the G-COM briefing of the underground workforce both of which were facilitated by the Longwall Deputy – the Shift Undermanager expected that the Longwall Deputy would have discussed the work task at both briefings, as it was listed on the Daily Plan, but that did not occur as the Longwall Deputy was preoccupied by flooding issues on the longwall.
  - It was not discussed by the Longwall Mechanical Coordinator with workers – there was an earlier brief discussion between Worker B and the Longwall Mechanical Coordinator on 6 December 2019, but the requirement to transport the PRS leg cylinder to PRS43 was not discussed on that date.
  - A “work pack” containing the mine’s Daily Plan and the *Chock Leg Transport and Install Procedure* was not provided to, or otherwise discussed with, workers.

Further, there existed significant limitations in the experience of Worker A in that he had:

- no experience performing the work task undertaken on the date of the incident, had not observed the task being performed and had not seen the *Chock Leg Transport and Install Procedure*
- not previously worked at Ulan Underground Mine when the longwall was producing coal, as he ordinarily performed work underground at the longwall when plant and equipment was shut down, and throughout his career as a maintenance fitter he usually conducted maintenance work on longwalls when they were not producing with plant and equipment shutdown.

### 5.5.3. Supervision

The Longwall Deputy, who was charged with responsibility for supervising the relevant workers on the date of the incident, was not involved in planning of the work activity, did not participate in a JSA or other risk assessment process related to the work activity, did not provide any information or instruction concerning the work activity, did not attend the work area at any time the workers undertook the work and did not otherwise have any involvement in the task of transporting the replacement PRS leg cylinder to PRS44. At the time the work activity was planned and executed the Longwall Deputy was preoccupied by flooding issues on the longwall.

As a result, the opportunity for the Longwall Deputy to identify and rectify the absence of isolation and adherence to ‘No-Go Zone’ rules as risk control measures was missed.

Other Ulan Underground Deputies interviewed during the investigation stated that the Longwall Deputy should have, as a minimum, been involved in certain stages of this task if not the entirety of the work task.

The absence of supervision provided by the Longwall Deputy takes on significance because it occurred in the following context:

- The task of transporting the replacement PRS leg cylinder to PRS44 was an infrequent task.
- The task was largely being undertaken by inexperienced workers, including Worker A, who had not been provided information, instruction or training concerning it.
- Poor communication between the Deputy and the workers resulted in confusion regarding whether the task was going to proceed on the date of the incident.
- Worker A was classified by the mine as an 'Inexperienced Underground Mine Worker' in accordance with its *Control & Supervision of Inexperienced Underground Operators* (referred to as a 'yellow hat') requiring closer (direct) oversight and supervision by a 'mentor' where necessary – refer 'NOTE' immediately following.
- The Undermanager had no, or limited, interaction with the contact maintenance fitters on the date of the incident to the extent he has no recollection of having any interaction with them.
- There was inconsistent understanding as to whether the development of SLAMs (not involving the Longwall Deputy) or a JSA (involving the Longwall Deputy) was required.
- There was an inconsistent and ill-disciplined approach to applying isolation and adhering to 'No-Go Zone' rules as risk controls for the relevant work task.

**NOTE:**

Worker A was classified by Ulan Underground as an 'Inexperienced Underground Mine Worker' in accordance with its *Control & Supervision of Inexperienced Underground Operators* procedure because of the short time he had worked at the mine. Controls provided by that procedure in the case of an 'Inexperienced Underground Mine Worker' included the provision of a 'mentor' who was required to maintain direct supervision where necessary to ensure the inexperienced underground worker is made aware of all hazards inherent in the underground coal-mining environment. The procedure also mandated that all inexperienced underground operators document and complete an 'Inexperienced Underground Operator Log-Book' for the supervision period.

However, Worker A was not under the direct supervision of a mentor at the time of the incident nor was a logbook completed by him.

#### 5.5.4. Periodic checking and management

Ulan Underground's *Contractors and Suppliers Management Plan* identified the Longwall Mechanical Coordinator as the 'Task Coordinator' for the contract maintenance fitters transporting the replacement PRS leg cylinder to PRS44.

Ulan Underground's *Contractors and Suppliers Management Plan* further provided that the 'Task Coordinator' (Longwall Mechanical Coordinator) should use safety management methods including task

inspections, safety interactions and planned task observations to monitor the contract workers' compliance with Ulan Underground's health and safety requirements.

The investigation failed to identify any documentary evidence to establish that the contract maintenance fitters were monitored by the 'Task Coordinator' (Longwall Mechanical Coordinator) under the Plan at any time prior to or on the date of the incident by means of inspections, safety interactions, planned task observations or otherwise.

### 5.5.5. Isolation requirements

The *Chock Leg Transport and Install Procedure* did not effectively provide for the implementation of risk controls to the extent it did not clearly mandate isolation as a control measure at the relevant (final) procedural step of the process during which the incident occurred – “*When the shearer reaches the required area lower the chock leg ram onto the chock toes using lifting gear and retain to support.*”

The high water mark in terms of isolation is that the *Chock Leg Transport and Install Procedure* depicted an isolation and restoration diagram at *Section 1 Purpose* in a very general context, which had some potential to trigger workers to consider isolation at the relevant (final) procedural step of the process during which the incident occurred, but did not go further to mandate isolation as a particular risk control at that step. In that regard, the control measures listed in relation to the relevant (final) procedural step include correct lifting / pulling technique, competent and trained personnel, correct rated lifting gear and 'No-Go Zones'. Isolation as a risk control is absent.

The *Chock Leg Transport and Install Procedure* did not otherwise incorporate by reference an isolation procedure or process for implementation during the relevant work task to clearly mandate isolation of a PRS when work was conducted on or in front of a PRS.

The ineffectiveness of the *Chock Leg Transport and Install Procedure* resulted in an ill-disciplined approach in practice to applying isolation as a risk control during the relevant work task because there was an inconsistent understanding on the part of workers as to when a PRS was required to be isolated when undertaking the task of securing equipment to PRS pontoons. In that regard, some workers recounted that they would not isolate a PRS if the task was only brief whereas others recounted that they would always isolate a PRS when conducting the relevant work task.

Had isolation been implemented as a risk control whilst the relevant work task was undertaken, PRS44 would not have moved and the risk of injury in fact sustained by Worker A avoided.

None of the workers involved the relevant work task, when interviewed, recalled isolation of PRS44 being discussed as a control measure during the development of SLAMs or otherwise on the date of the incident.

More broadly, Ulan Underground was unable to locate any SLAMs or JSAs concerning the transport of a PRS leg cylinders completed either on the date of the incident or in the 12 months preceding it. In that

context it is impossible to determine whether unexpected movement was identified as a potential risk associated with the task of transporting a PRS leg cylinder and whether isolation was implemented as a control measure to manage that risk.

### 5.5.6. Acts or omissions of workers

The following acts or omissions of workers, including those directly involved in the task of transporting the replacement PRS leg cylinder to PRS44 as well as those overseeing it, contributed to the cause and surrounding circumstances of the incident – the failure to implement control measures to manage the risk of unexpected movement of the PRS:

- The Longwall Mechanical Coordinator did not provide a 'work pack' to Workers A, B and C on the date of the incident. Such a 'work pack' would usually include the Daily Plan as well as applicable procedures for tasks to be completed that shift (i.e. *Chock Leg Transport and Install Procedure*) but, on the date of the incident, no such 'work pack' was provided to the workers. Consequently, the contract maintenance fitters were not provided with sufficient information regarding their required tasks for the shift and the work task requiring transport of a PRS leg cylinder to PRS43 was not known to Workers A, B and C upon commencement of their shift.
- The Longwall Deputy failed to discuss the item on the Daily Plan for 7 December 2019 that concerned transportation of a PRS leg cylinder to PRS43, during either the pre-start briefing of the entire crew or the G-COM briefing of the underground workforce, as he was focused on flooding issues on the longwall. As a result, Workers A, B and C remained unaware of the task for much of their shift.
- The Longwall Deputy also failed to perceive a conversation on the DAC that involved Worker B and concerned transportation of a replacement PRS leg cylinder as an indication that the task was being commenced by workers. As a result, the Longwall Deputy failed to attend the work area where the task was being undertaken at any stage and did not provide any supervision over the task.
- Worker A and the shearer operator manually advanced PRS44, and then relied upon visual assessment that PRS44 had fully advanced to the AFC as a measure to control the risk of its unexpected movement despite this not being a control measure mandated by the mine's safety management system.
- Worker A and the shearer operator did not consider implementing isolation as a control measure whilst the replacement PRS leg was being secured to the pontoon of PRS44 despite being aware that was available to them as a control.
- The shearer operator commenced a second task (movement of the shearer towards the tailgate where it was to be parked up at PRS60) simultaneously with the first task (securing the PRS leg

cylinder to PRS44) without firstly ensuring that Worker A and the mine worker removed themselves from the 'No-Go Zone' created by the simultaneous operations – the commencement of the second task resulted in Worker A and the mine worker being exposed to risk as movement of the shearer placed them into a 'No-Go Zone' located between the last advanced PRS and the trailing drum of the shearer.

- Worker A and the mine worker, both of whom had been trained in 'No-Go Zone' rules, did not remove themselves from the 'No-Go Zone' created by the movement of the shearer when the shearer operator advised them he was moving the shearer nor did they respond to audible and visual alarms indicating imminent activation of the PRS.

**NOTE:**

- i. SafeCoal Rule 4 – Never enter 'No-Go Zones' was generally well understood and implemented by workers. Seven Deputies and four statutory position holders that provided evidence during the investigation identified that to be the case. The notable exception was the shearer operator who, whilst acknowledging that it was considered 'best practice' to comply with the 'No-Go Zone' rule, identified that workers did not always comply with it and an Undermanager who identified occasional instances of workers breaching the 'No Go-Zone' rule when passing by the shearer or working on the return side of the shearer.
- ii. Each PRS on the longwall face is fitted with an RS20s mimic control unit which includes a built-in audible alarm and visual warning that are activated prior to any PRS advancing. When automation is active, all mimic units in the automation zone display a flashing red LED light. Both Worker A and the mine worker informed investigators that, at the material time, they were looking down at the work being conducted on PRS44 and the flashing light on the mimic unit was not within their line of sight. The mine worker asserted he was unable to hear the audible alarm, due to the noisy environment coupled with hearing protection, and Worker A asserted that he was unable to recall hearing the alarm but did not provide a reason.

## 5.6. Post incident remedial measures

In response to the incident, Ulan Underground replaced the *Chock Leg Transport and Install Procedure* with an updated document entitled *PRS Leg Cylinder Transport and Replacement Procedure*.

The updated *PRS Leg Cylinder Transport and Replacement Procedure* includes:

- reformatted procedure for clarity
- provision of more detailed instructions on how to implement risk controls
- addition of a clearly described step for securing a PRS leg cylinder to the PRS pontoon
- addition of a requirement for workers to mechanically isolate the relevant PRS during the transport component of the procedure

- recommendation to use two ratchet straps to secure the PRS leg cylinder onto the pontoon as opposed to a chain block as used by Worker A on the date of the incident.

In addition to the *PRS Leg Cylinder Transport and Replacement Procedure*, Ulan Underground developed a new procedure titled *Transportation of Equipment Using Shearer Carry Arm* which is directed specifically to the task Worker A was conducting at the time of the incident.

The *Transportation of Equipment Using Shearer Carry Arm* describes the unloading of equipment from the shearer carry arm and includes:

- Instructions to hydraulically isolate the PRS where the equipment is to be located.
- Electrically disengaging adjacent roof supports located on the maingate and tailgate side of the work area.
- Isolating and locking out the shearer with a personal lock.

On 17 and 19 June 2020 Ulan Underground conducted a risk assessment workshop to identify whether procedures could be further enhanced to manage risks associated with the movement of PRSs. Some of the action items included:

- Action Item 5 resulting – updating the *PRS Hydraulic Isolation Procedure* to include a requirement that multiple PRSs are isolated when working on, between or beside a PRS.
- Action Item 10 – updating the *Transportation of Equipment Using Shearer Carry Arm* procedure to include locking the stop button into position on the shearer when unloading equipment from the shearer carry arm.
- Action Item 13 – review and update of the *Longwall Safety Overview* to include a requirement for workers who are working in front of a PRS to at minimum electrically disengage that PRS as well as one PRS on each side.

Further, additional training was provided to longwall workers which emphasised the importance of 'Restricted Zones' and 'No-Go Zones'.

Ulan Underground implemented a site safety campaign titled 'No Plan, No Work' which emphasised the importance of risk assessment planning including SLAMs and JSAs.

Ulan Underground upgraded record keeping requirements in relation to SLAMs which were to be increased from a minimum retention period of three months to an increased retention period of 12 months.

## 6. Industry recommendations

It is recommended that mine operators:

1. in consultation with workers, systematically analyse face line tasks and identify all reasonably foreseeable acts or omissions of workers when developing risk control measures
2. consider proximity detection systems for automated roof support systems to detect worker location and to prevent movement when workers are in positions of risk, in addition to considering lower order administrative controls<sup>1</sup>
3. detail all risks and risk controls associated with each step involved in transporting and storing PRS leg cylinders (and other equipment) on a longwall face in a clearly documented procedure or similar that includes the following risk control measures:
  - a. The applicable risk management process to be applied to a work task.
  - b. Hydraulic isolation (including lock and tag-out) when work is conducted on or in front of a PRS to prevent unexpected movement of PRS.
  - c. 'Restricted Zone' and 'No-Go Zone' rules when work is conducted contemporaneously with shearer operation.
4. Develop and implement administrative controls to increase compliance by workers with each step involved in transporting and storing PRS leg cylinders (and other equipment) on a longwall face and verify their implementation in practice, including the following controls:
  - a. Information, instruction and training.
  - b. Communication and consultation.
  - c. Supervision and management.
  - d. Periodic checking, monitoring and verification.
  - e. Means of holding individuals accountable for implementation.

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<sup>1</sup> Proximity detection systems for automated PRSs are a technology currently being introduced into some underground coal mines in New South Wales. Proximity detection systems are designed to identify the location of personnel, initiate alarms and stop machine movement if a person is in a position of risk.



It is recommended that:

1. workers vigilantly apply administrative risk control measures such as isolation, 'Restricted Zone' and 'No-Go Zone' rules
2. shearer operators ensure before commencing, and during shearer movement, all workers in the vicinity of a shearer are complying with 'Restricted Zone' and 'No-Go Zone' rules
3. all workers hold each other accountable for compliance with administrative risk control measures and remain attentive and responsive to visual and audible alarms.