Resources Regulator
Department of Regional NSW

NSW GOVERNMENT

Consolidated report

Electrical engineering control plan – exposure to an uncontrolled release of electrical energy – coal mines – stage 1

May 2021 to December 2022

Published by the Department of Regional NSW

Title: Consolidated report – Electrical engineering control plan – exposure to an uncontrolled release of electrical energy – coal mines – stage 1

First published: February 2023

Department reference number: RDOC22/267747

More information

Amendment schedule		
Date	Version	Amendment
February, 2023	1	First published

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Executive summary

A crucial part of the NSW Resources Regulator's *Incident Prevention Strategy* involves targeted assessment and planned inspection programs for mines and petroleum sites. This is a focus on assessing an operation's control of critical risks through evaluating the effectiveness of control measures in the mine's safety management system.

The Regulator has developed a bowtie hazard management framework and standardised assessment checklist for each program plan. Under each program plan, the effectiveness of the safety management system at each mine site is assessed against a standard set of control supports and critical controls. Various controls were derived from the bowtie, therefore this report summarises controls included in Stage 1. The remaining controls will be assessed in Stage 2.

This report summarises the assessment findings from 60 coal mines in relation to assessments for the hazard of (electrical engineering control plan - exposure to an uncontrolled release of electrical energy). The assessments were conducted over two programs, below surface and above surface, between May 2021 and December 2022.

The threats and critical controls assessed for the material unwanted event (electrical engineering control plan - exposure to an uncontrolled release of electrical energy) are shown in Table 1.

Table 1: Threats and critical controls for the material unwanted event (electrical engineering control plan - exposure to an uncontrolled release of electrical energy)

THREAT/CONSEQUENCE		CRITICAL CONTROL
Threat	• Direct contact with electricity	PC 1.2 – Identify electrical services
Threat	• Direct contact with electricity • Arc blasts	PC 1.4 – Energy isolation
Threat	• Direct contact with electricity • Indirect contact with electricity	PC 1.6 – Reduced voltage

Legislative requirements and published guidance relating to the principal control plan (electrical engineering control plan - exposure to an uncontrolled release of electrical energy) is listed in Appendix A. Figures 1-5 present safety compliance findings for each deidentified mine and critical control assessed for the material unwanted event of (electrical engineering control plan - exposure to an uncontrolled release of electrical energy). Explanatory notes on the assessment system are also listed in Appendix B.

Key findings

Critical control: PC 1.2 – Identify electrical services

Most mines assessed as part of this program had identified hazards associated with electrical services.

The risk assessments were conducted using a cross section of the workforce at the site. They had further identified and implemented measures to control the hazard.

Control measures include:

- the use of permits for both ground penetration and other activities to be conducted within proximity to electrical services
- signs and notices to warn of the presence of electricity were generally present

- availability of up-to-date plans showing the location of electrical services on site
- people on site who may be exposed to the hazards were familiar with the procedures for working in the vicinity of electricity.

Critical control: PC 1.4 – Energy isolation

Energy isolation, covers 3 main areas - hardware, procedures and competency.

Most mines have implemented systems that require the hardware (isolators), to be installed on mobile and fixed plant.

- The isolators were generally observed to be well maintained.
- The requirement to have the off and on positions clearly identified was well understood.

The assessment program found some deficiencies with procedures and permits still existed at some sites.

Several issues were identified about the competency of workers using isolation systems, including understanding different isolation process (comissioning / function checks and group isolations).

Critical control: PC 1.6 – Reduced voltage

This program assessed the use of extra low voltage (ELV) as an engineering control for control systems, portable electrical apparatus, and welding equipment to reduce the risk of electric shock.

Most operations have adopted ELV for field devices as a site standard, and have either fully implemented, or have plans in place to change out field devices to operate at ELV.

Operations generally had systems in place to manage portable electrical apparatus with many sites assessed having adopted an approach to challenge the use of 240Va.c. power tools and had a documented preference for using battery-powered tools.

Many sites adopted a permit system to assess whether the environment was suitable for using 240Va.c. power tools.

The assessment program identified some issues with maintenance and inspection programs, whether it be test-and-tag compliance or pre-use inspections of portable tools and leads.

Sites appeared to have systems in place to manage welding equipment to ensure they were fit-for-purpose. Further sites had procedures for the pre-use inspection and use of welding equipment, but when confirming these systems were being fully complied with in the field, it was evident some aspects required improvement.

Areas noted were the completion of hot work permits, and the user understanding those permits, fit-for-purpose equipment, pre-use inspections, damaged leads and current inspection and tagging compliance.

Recommendations

Critical control: PC 1.2 – Identify electrical services

- The location of electrical services needs to be readily available to workers who need to carry out excavation, wall penetration and other activities that may expose them to the hazards of electricity.
- Plans and drawings of electrical services need to be accurate and up-to-date to be effective.
- Sites should adopt permit systems when workers are required to operate in the vicinity of electrical services.
- When assessing whether a machine can encroach on approach distances, the full operating envelope of the machine needs to be considered.

- When assessing situations for working in the vicinity of electrical services, the assessment should include the possibility of isolating the service and eliminating the risk.

Critical control: PC 1.4 – Energy isolation

- For isolation procedures to remian effective, they need to be reviewed regularly.
- The reviews should include the workers that will be required to use them.
- Reviews should be conducted for each new item of plant introdcued to site.

Critical control: PC 1.6 – Reduced voltage

- Using battery-powered portable tools greatly reduces the risk of electrocution. Sites should assess whether it is safe to use mains powered tools in the environment. The use of class II tools should be avoided in wet and hostile environments.
- Operations should initiate programs of upgrading control circuits including field devices to operate at extra low voltage.
- Sites should review using hazard reduction devices and welding practices to ensure that electrical safety is being maintained.

Findings by mine

Figures 1-5 present aggregate assessment findings by threat and critical control, providing a summary view of the status of each mine's hazard management processes. Importantly, the system recognises the value of fully implemented and documented controls by awarding an additional point if both elements were assessed as present. More details explaining the assessment system are at Appendix B.

Figure 1: Assessment findings for the planned inspection program – electrical engineering control plan – exposure to an uncontrolled release of electrical energy – coal mines – stage 1 – overall results <100%

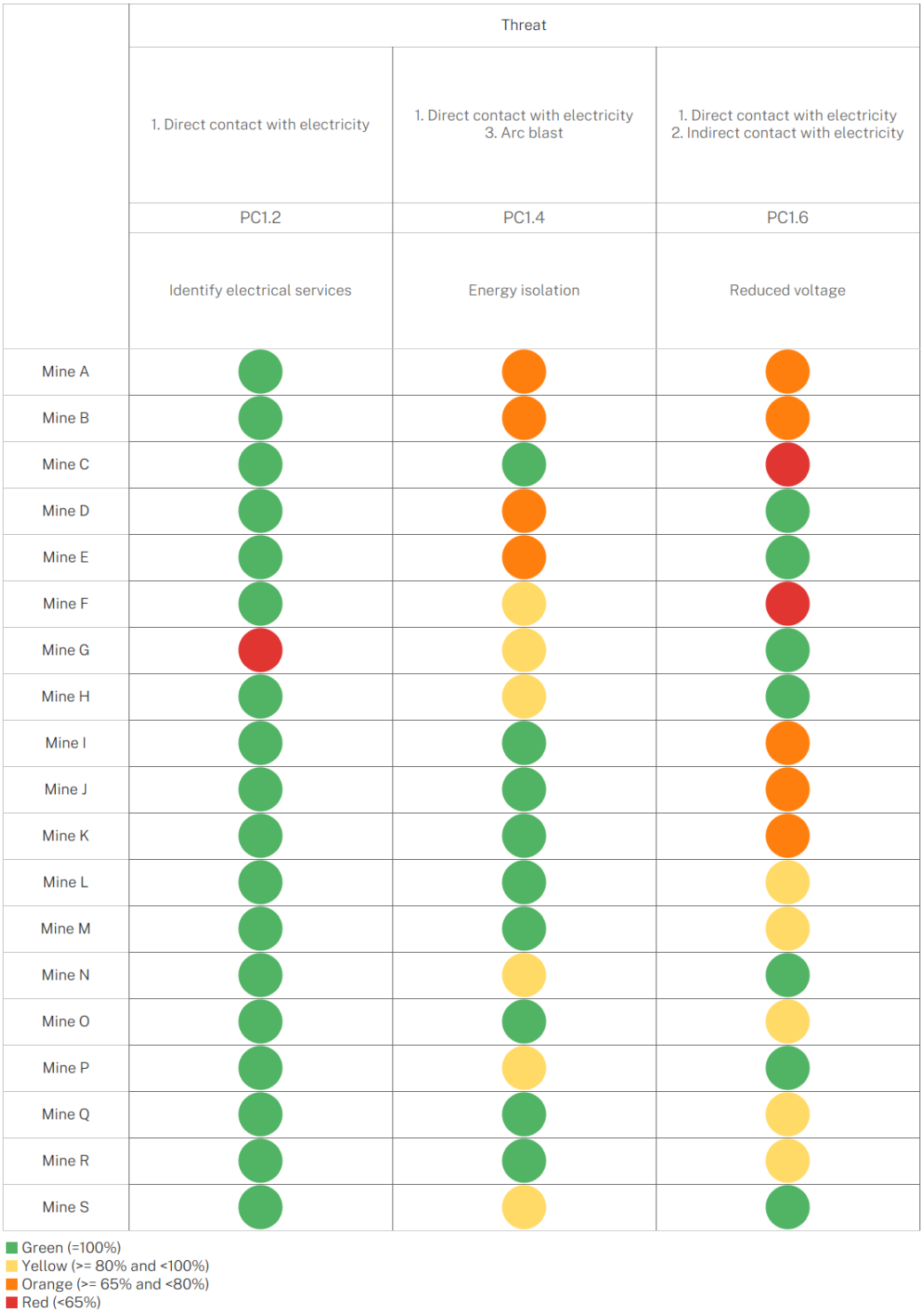

Figure 2: Assessment findings for the planned inspection program – electrical engineering control plan – exposure to an uncontrolled release of electrical energy – coal mines – stage 1 – overall results =100%

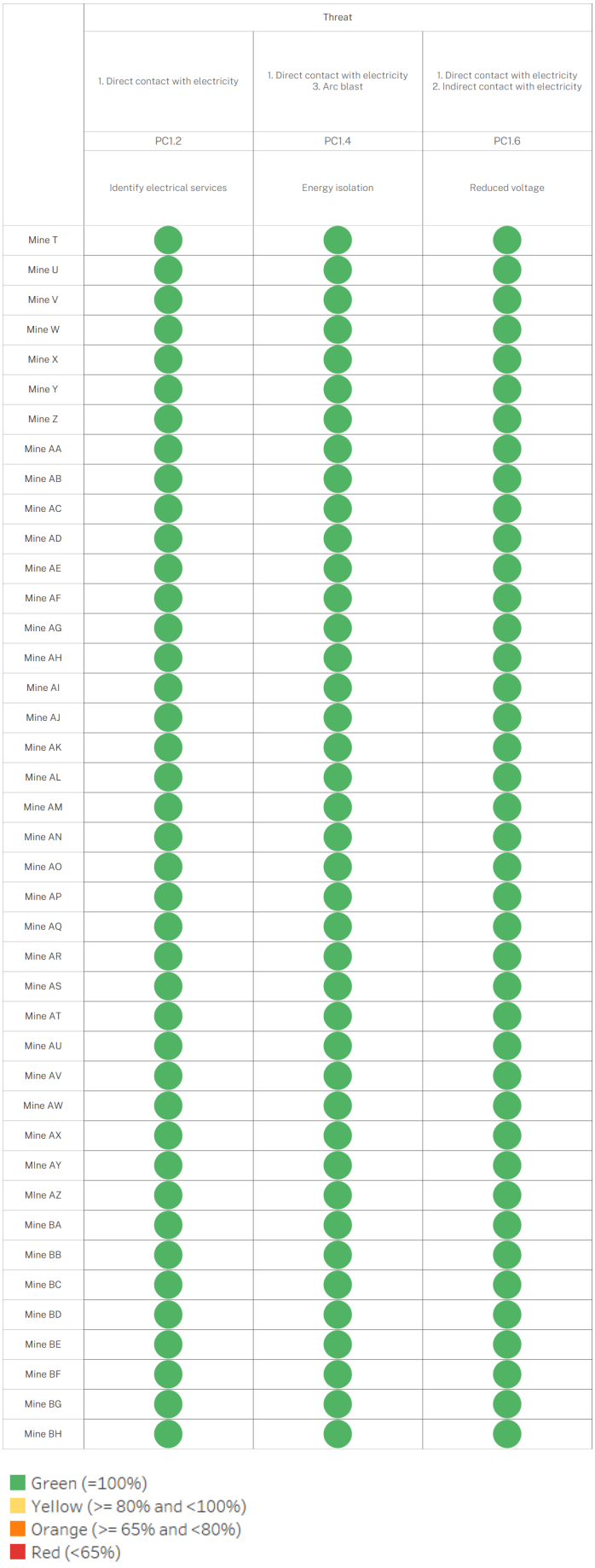

Figure 3: Assessment findings for the planned inspection program – electrical engineering control plan – exposure to an uncontrolled release of electrical energy – coal mines – stage 1 – below surface

		Threat		
		1. Direct contact with electricity	1. Direct contact with electricity 3. Arc blast	1. Direct contact with electricity 2. Indirect contact with electricity
		PC1.2	PC1.4	PC1.6
		Identify electrical services	Energy isolation	Reduced voltage
Below surface	Mine C	Green	Green	Red
	Mine D	Green	Orange	Green
	Mine L	Green	Green	Yellow
	Mine P	Green	Yellow	Green
	Mine S	Green	Yellow	Green
	Mine U	Green	Green	Green
	Mine V	Green	Green	Green
	Mine W	Green	Green	Green
	Mine AA	Green	Green	Green
	Mine AB	Green	Green	Green
	Mine AD	Green	Green	Green
	Mine AJ	Green	Green	Green
	Mine AM	Green	Green	Green
	Mine AO	Green	Green	Green
	Mine AU	Green	Green	Green
	Mine AX	Green	Green	Green
	Mine BA	Green	Green	Green
	Mine BD	Green	Green	Green
	Mine BG	Green	Green	Green

Green (=100%)
Yellow (>= 80% and <100%)
Orange (>= 65% and <80%)
Red (<65%)

Figure 4: Assessment findings for the planned inspection program – electrical engineering control plan – exposure to an uncontrolled release of electrical energy – coal mines – stage 1 – above surface – overall results < 100%

		Threat		
		1. Direct contact with electricity	1. Direct contact with electricity 3. Arc blast	1. Direct contact with electricity 2. Indirect contact with electricity
		PC1.2	PC1.4	PC1.6
		Identify electrical services	Energy isolation	Reduced voltage
Above surface	Mine A	Green	Orange	Orange
	Mine B	Green	Orange	Orange
	Mine E	Green	Orange	Green
	Mine F	Green	Yellow	Red
	Mine G	Red	Yellow	Green
	Mine H	Green	Yellow	Green
	Mine I	Green	Green	Orange
	Mine J	Green	Green	Orange
	Mine K	Green	Green	Orange
	Mine M	Green	Green	Yellow
	Mine N	Green	Yellow	Green
	Mine O	Green	Green	Yellow
	Mine Q	Green	Green	Yellow
	Mine R	Green	Green	Yellow

Green (=100%)
Yellow (>= 80% and <100%)
Orange (>= 65% and <80%)
Red (<65%)

Figure 5: Assessment findings for the planned inspection program – Electrical engineering control plan – exposure to an uncontrolled release of electrical energy – coal mines – stage 1 – above surface – overall results = 100%

		Threat		
		1. Direct contact with electricity	1. Direct contact with electricity 3. Arc blast	1. Direct contact with electricity 2. Indirect contact with electricity
		PC1.2	PC1.4	PC1.6
		Identify electrical services	Energy isolation	Reduced voltage
Above surface	Mine T	●	●	●
	Mine X	●	●	●
	Mine Y	●	●	●
	Mine Z	●	●	●
	Mine AC	●	●	●
	Mine AE	●	●	●
	Mine AF	●	●	●
	Mine AG	●	●	●
	Mine AH	●	●	●
	Mine AI	●	●	●
	Mine AK	●	●	●
	Mine AL	●	●	●
	Mine AN	●	●	●
	Mine AP	●	●	●
	Mine AQ	●	●	●
	Mine AR	●	●	●
	Mine AS	●	●	●
	Mine AT	●	●	●
	Mine AV	●	●	●
	Mine AW	●	●	●
	MIne AY	●	●	●
	MIne AZ	●	●	●
	Mine BB	●	●	●
	Mine BC	●	●	●
	Mine BE	●	●	●
	Mine BF	●	●	●
	Mine BH	●	●	●

Green (=100%)
Yellow (>= 80% and <100%)
Orange (>= 65% and <80%)
Red (<65%)

Notices issued

Of the 60 sites assessed under the inspection program, 26 separate mines were given notices relating to the principal control plan of (electrical engineering control plan - exposure to an uncontrolled release of electrical energy), while some mines were given notices in relation to other matters. For the purposes of this report, contraventions related to other matters were removed from the analysis. The notices issued for (electrical engineering control plan - exposure to an uncontrolled release of electrical energy) were examined in detail and Table 2 below lists the notices issued by type and details.

Table 2: Notices issued for the planned inspection program – electrical engineering control plan – exposure to an uncontrolled release of electrical energy – coal mines – stage 1

NOTICE TYPE	TOTAL ISSUED	NUMBER OF MINES
s.195 prohibition notice	5	4
s.191 improvement notice	43	21
s.23 notice of concerns	16	15
Total	**64**	**26**

Of the combined 64 notices issued, there were some common themes that were apparent throughout the program plan. Table 3 summarises the type of contraventions. These themes can be related to the critical controls outlined earlier and identify some trends that are of concern.

Table 3: Notices issued - prevalence of categories of concern

IDENTIFIED CONCERN CATEGORY
The general condition of forklifts was the subject of a number of notices. As a result, a safety bulletin was issued to raise awareness of the need for properly maintained forklifts.
Risk assessments underpinning the electrical engineering control plan not conducted in accordance with Section 14 and not addressing the risks associated with electricity detailed in the legislation.
Electrical engineering control plans not addressing all the items in Schedule 2.
Written procedures not followed by all site personnel.

Further information

For more information on safety assessment programs, the findings outlined in this report, or other mine safety information, please contact the NSW Resources Regulator:

CONTACT TYPE	CONTACT DETAILS
Email	cau@regional.nsw.gov.au
Incident reporting	To report an incident or injury call 1300 814 609 or log in to the Regulator Portal
Website	www.resourcesregulator.nsw.gov.au
Address	NSW Resources Regulator 516 High Street Maitland NSW 2320

Appendix A. Legislative requirements and published guidance relating to the principal control plan (electrical engineering control plan - exposure to an uncontrolled release of electrical energy)

The following is a list of certain legislative requirements for the management of (electrical engineering control plan - exposure to an uncontrolled release of electrical energy) risks referred to in this report, as provided by the Work Health and Safety (Mines and Petroleum Sites) Regulation 2022 and Work Health and Safety Regulation 2017.

Work Health and Safety (Mines and Petroleum Sites) Regulation

- Part 3 Division 2 Section 30 (5) requires all operations where there is a risk to health and safety from electricity must prepare an electrical engineering control plan.
- (a) requires that the risks associated with electricity must be conducted in accordance with section 14.
- Schedule 2 Principal Control Plans Section 3 Electrical Engineering Control Plan.
- Electrical Engineering Control Plan NSW code of practice | WHS(MPS) legislation

Work Health and Safety Legislation

- Part 4.7 General electrical safety in workplaces and energised electrical work
- Division 1 - 7

Safety Alerts

- Safety alert: Severe electric shock from power tool
- Safety alert: Electric shock direct contact with high-voltage electricity
- Electric shock from 11 kv bus tie
- Safety alert: Serious electric shock incident

Safety Bulletins

- Electric shocks in the mining industry
- Welding-related electric shocks increase
- Electric shocks

Appendix B. Assessment system explained

The NSW Resources Regulator uses a bowtie framework to proactively assess how mine sites manage their principal hazards. Bowties are a widely used risk management tool that integrates preventative and mitigating controls onto threat lines that relate to a material unwanted event.

As part of program planning, controls were categorised by the NSW Resources Regulator's mine safety inspectorate in accordance with the ICMM handbook. Only controls deemed critical[1] are assessed under a planned inspection program. For a control to be assessed as effective, each of its control supports must be in place and operational.

Assessment findings results calculation

During the program, each control support assessed at each mine was rated and the findings recorded. Points were awarded depending on whether there was evidence that the control support had been documented and / or implemented. Importantly, the system recognises the value of fully implemented and documented controls by allocating four points if both these elements were present.

For finding outcomes, points were awarded for each control support identified within a critical control. An overall assessment result for the critical control was then calculated as a proportion of the maximum possible points for that critical control. For example, if a critical control comprises ten control supports and five were assessed as fully implemented ('documented and implemented') and five were found to be 'not documented and not implemented' then the overall assessment result for that critical control would be 50%.

Table 3: Finding outcome and points

FINDING OUTCOME	POINTS
Documented and implemented	4
Implemented but not documented	2
Documented but not implemented	1
Not documented and not implemented	0

Critical control calculations also took into account instances where control supports were not applicable to the mine being assessed or when control supports were not able to be assessed during a site visit.

The overall assessment result for each critical control has been assigned a colour based on the assessment bands presented in the table below. The colour band results are then used to identify industry focus areas requiring improvement.

Table 4: Assessment results and colour code

CRITERIA	COLOUR
An assessment result of 100% of possible points	Green
An assessment result of ≥ 80% but < 100% of possible points	Yellow
An assessment result of ≥ 65% but < 80% of possible points	Orange
An assessment result of < 65% of possible points	Red

[1] Critical Control Management Implementation Guide, International Council on Mining and Metals (ICMM), 2015.