Resources Regulator
Department of Regional NSW

Consolidated report

Mechanical engineering control plan

Structural collapse

Coal mines above surface

July 2021 to June 2023

Published by the Department of Regional NSW

Title: Consolidated report – Mechanical engineering control plan–structural collapse-coal mines above surface–July 2021 to June 2023

First published: September 2023

Department reference number: RDOC23/188497

More information

Amendment schedule		
Date	Version	Amendment
September 2023	1	First published

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Executive summary

A crucial part of the NSW Resources Regulator's Incident prevention strategy for mines and petroleum sites involves:

- targeted assessments and planned inspection programs - focusing on assessing an operation's control of critical risks through evaluating the effectiveness of control measures in the mine's safety management system
- priority programs - proactively assessing a topic that is an emerging risk across the industry, which is driven primarily from incident data as well as evolving industry trends. Although these topics may also be contained within the Regulator's planned inspection programs, the aim of compliance priority programs is to gather further information and knowledge about how the industry is managing and controlling a specific issue.

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.

Structural collapse at coal mines (open cut and underground mines) above surface locations was one of the hazards identified in the mechanical engineering control plan (MECP) bow tie. These types of hazards can occur within various mining environments and have the potential to cause serious and/or fatal injuries to workers if not controlled effectively. An inspection program was developed to assess how mines are prepared to manage that risk.

Explanatory notes on the assessment system are also listed in Appendix A.

For the **41** coal mine sites (19 open cut mines, 14 coal processing sites and 8 underground mines) there were 1,353 individual assessment findings and of those 166 assessment findings required enforcement action to be taken. The assessment program was conducted between July 2021 and June 2023.

There were **37** compliance notices in total issued to **25** mines in relation to this assessment program.

The types of compliance notices issued consisted of **25** WHS(MPS)A *s23* notices of concern, **11** WHSA s191 improvement notices and 1 WHSA s195 prohibition notice.

Assessment criteria

Critical controls were identified by the Regulator and assessment criteria were assigned to each potential threat.

A tabulation of the threat, critical control and criteria for the program plan mechanical engineering control plan, structural failures at coal mines above surface locations exposing people to risk is provided in Table 1.

Table 1. Threats and critical controls assessed for the planned inspection program mechanical engineering control plan – structural collapse – coal mines above surface (1505)

Threat		Critical control	Criteria
1.	Impact damage	PC 1.1	Structural integrity
2.	Overload		
3.	Progressive weakening of structure (wear corrosion, fatigue)		
4.	Foundation degradation		
5.	Natural event		
1.	Impact damage	PC 1.2	Traffic management
2.	Overload	PC 2.2	Operate within design limits
3.	Progressive weakening of structure (wear corrosion, fatigue)		
		PC 2.3	Repair modification quality assurance
3.	Progressive weakening of structure (wear corrosion, fatigue)	PC 3.2	Corrosion protection

Findings

Overall, the findings were:

- 41 site assessments reviewed for this report:
  - 19 open cut mines
  - 14 coal processing sites
  - 8 underground mines
- 1,353 individual findings
  - 116 findings with enforcement action recorded.
- 37 compliance notices in total issued to 25 mines:
  - 25 *WHS(MPS)A s23* notices of concern
  - 11 *WHSA s191* improvement notices
  - 1 *WHSA s195* prohibition notice

The overall assessment findings by threat and criteria is 93% (refer Figure 1):

- the lowest assessed score threat of impact damage ranked 84%
- the highest assessed score threat of progressive weaking of structure ranked 96%

Figure 1. Summary assessment findings overall results by threat/consequence and critical control

Threat					Grand Total
1. Impact damage 2. Overload 3. Progressive weakening of structure (wear, corrosion, fatigue) 4. Foundation degradation 5. Natural event	1. Impact damage	2. Overload 3. Progressive weakening of structure (wear, corrosion, fatigue)		3. Progressive weakening of structure (wear, corrosion, fatigue)	
PC 1.1	PC 1.2	PC 2.2	PC 2.3	PC 3.2	
Structural integrity	Traffic management	Operate within design limits	Repair modification quality assurance	Corrosion protection	
94%	84%	96%	91%	96%	93%

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

The overall assessment findings by critical control and control support (refer to Figure 2):

- the threat of impact damage - traffic management ranked lowest at 77 %
- the threat of overload-operating within limits, progressive weakening of structure ranked 100%

Figure 2. Summary assessment findings overall results by critical control and control support

	Threat					Grand Total
	1. Impact damage 2. Overload 3. Progressive weakening of structure (wear, corrosion, fatigue) 4. Foundation degradation 5. Natural event	1. Impact damage	2. Overload 3. Progressive weakening of structure (wear, corrosion, fatigue)		3. Progressive weakening of structure (wear, corrosion, fatigue)	
	PC 1.1	PC 1.2	PC 2.2	PC 2.3	PC 3.2	
Control support number	Structural integrity	Traffic management	Operate within design limits	Repair modification qua..	Corrosion protection	
01	93%	83%	95%	88%	98%	91%
02	95%	77%	95%	86%	100%	90%
03	90%	92%	100%	93%	100%	95%
04	94%		96%	96%	96%	95%
05	96%		97%		88%	94%
06	99%				99%	99%
07	95%				95%	95%
08	94%				95%	94%
09	95%					95%
10	95%					95%
11	88%					88%
12	92%					92%
13	92%					92%
Grand Total	94%	84%	96%	91%	96%	93%

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

Critical controls - control support - criteria text – assessment finding (Figures 3 to 7)

Figure 3. Summary assessment findings overall results by critical control and control support – PC1.1 Structural integrity

Critical control number	Critical control	Control support number	Criteria Text	
PC 1.1	Structural integrity	01	Verify that structural integrity related routine inspection and maintenance is being completed to schedule.	93%
		02	Verify that structural audits are completed at the specified frequency.	95%
		03	Confirm that structural audit reports are authorised by a Certified Practicing Engineer (CPEng).	90%
		04	Confirm that routine inspection reports and structural audits are reviewed so that those accountable are aware of identified defects and required action.	94%
		05	Confirm the structural audit scope includes all plant and structures that could expose people to risk if they failed.	96%
		06	Confirm that a process has been nominated for determining the structural integrity of plant or structures that were out of scope for the structural integrity audits.	99%
		07	Confirm that defects identified during inspections and structural audits are recorded and prioritised in a system for managing defects.	95%
		08	Confirm that the prioritised defects are rectified to schedule.	94%
		09	Confirm that the continued operation of any plant or structures with high priority defects has been assessed and any additional controls completed before using the plant or structure.	95%
		10	Verify the mine process for managing change was applied to the changes that could impact the structural integrity of the plant or structure.	95%
		11	Verify that a vibration study has been completed and actions identified.	88%
		12	Verify that plant and structure foundations are free from evidence of corrosion, impact damage, coal, ore, or stone build up or exposed steel reinforcing on any concrete foundation.	92%
		13	Verify unused plant or structures are secured in a manner that prevents risk of harm to people.	92%

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

Figure 4. Summary assessment findings overall results by critical control and control support – PC1.2 Traffic management

Critical control number	Critical control	Control support number	Criteria Text	
PC 1.2	Traffic management	01	Verify that the plant and structures exposed to mobile equipment impact risks have been identified.	83%
		02	Confirm the specified traffic management controls are implemented.	77%
		03	Confirm supervisors and operators can explain the traffic management controls for mobile equipment operating in the vicinity of plant or structures.	92%

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

Figure 5. Summary assessment findings overall results by critical control and control support – PC2.2 Operate within design

Critical control number	Critical control	Control support number	Criteria Text	
PC 2.2	Operate within design limits	01	Verify that the load capacity of the plant and structures is known.	95%
		02	Confirm the specified load limiting controls are implemented.	95%
		03	Confirm supervisors and operators can explain the load limits and load limit controls for any operator-controlled plant and structure loading functions.	100%
		04	Verify the mine has systems in place to determine • the life cycle position of plant and structures susceptible to load and fatigue related structural failure. • any work required to extend the life of plant.	96%
		05	Confirm the work identified as being required to extend the life of plant and structures has been completed to allow for continued safe operation.	97%

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

Figure 6. Summary assessment findings overall results by critical control and control support – PC2.3 Repair modification quality assurance

Critical control number	Critical control	Control support number	Criteria Text	
PC 2.3	Repair modification quality assurance	01	Verify the specified structural repair or modification procedures were produced.	88%
		02	Confirm the repair or modification procedures describe the: • Qualifications of people completing the repair or modification. • Material specifications. • Welding procedures including welding consumables required, surface preparation, weld preparation, weld inspections and any required non-destructive testing. • Fasteners and mechanical connections installation procedures. • Hold points during repair or modification. • Required quality assurance checks.	86%
		03	Confirm that the technician can relate the key elements of the repair and modification process outlined in the safety management system: • Approval process for repairs or modifications to be carried out. Note: The hot work permit process may trigger a question related to the work impacting structural integrity and the required approval process. • Competency requirements of people carrying out repairs or modifications. • Documented repair and modification procedures supplied. • Quality assurance process for completed repairs and modifications. • Competency of people carrying out post repair or modification quality assurance.	93%
		04	Confirm the required repairs have been carried out and post work quality assurance has been completed.	96%

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

Figure 7. Summary assessment findings overall results by critical control and control support – PC3.2 Corrosion protection

Critical control number	Critical control	Control support number	Criteria Text	
PC 3.2	Corrosion protection	01	Verify that containment vessels and structural materials in contact with corrosive substances are resistant to corrosion.	98%
		02	Confirm that leaks of corrosive substances are treated to prevent structural integrity impacts.	100%
		03	Verify that bimetal corrosion controls are visible and maintained.	100%
		04	Verify that water is prevented from pooling around structural members.	96%
		05	Confirm that spillage or waste material that may hold moisture is not accumulating against structural members.	88%
		06	Confirm the condition of plant or structures protective coatings is regularly inspected.	99%
		07	Confirm that protective coatings are maintained, for example by renewal.	95%
		08	Confirm the condition and effectiveness of protective coatings by visual inspection.	95%

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

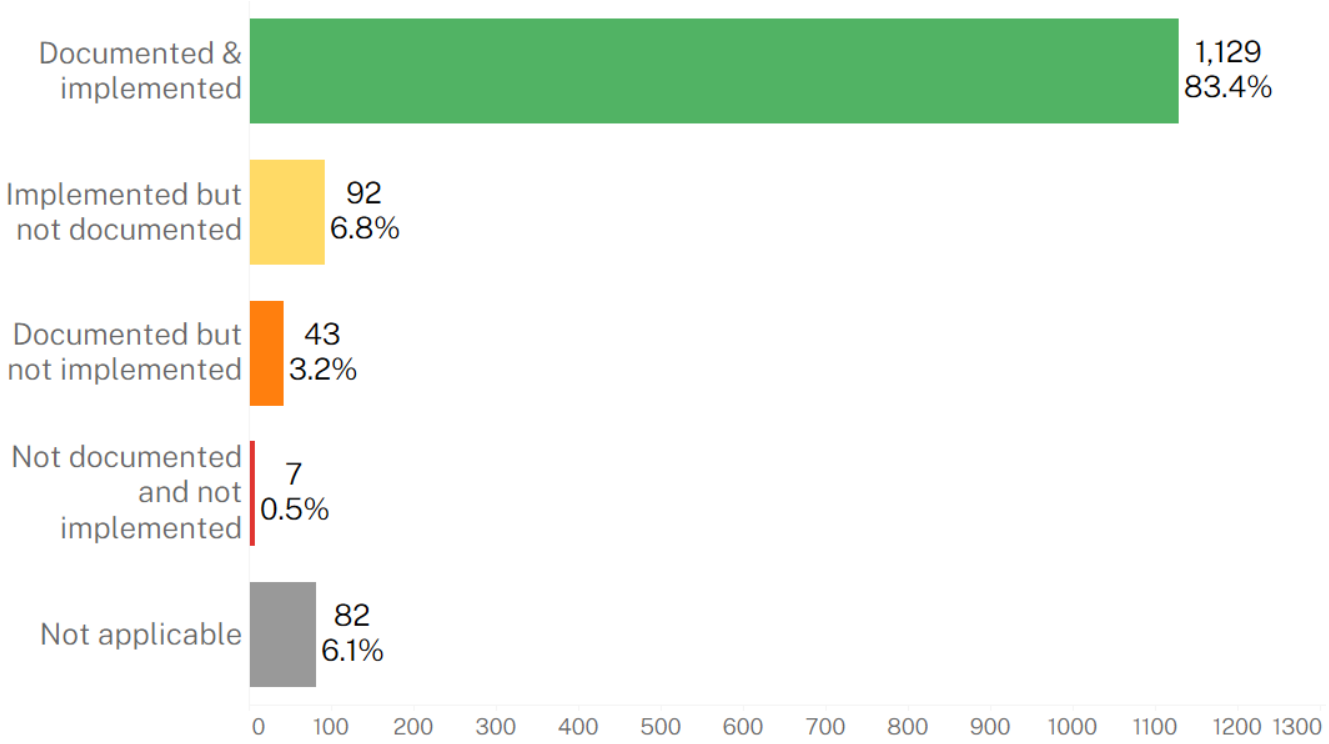
The overall analysis of assessment findings ratings were assessed to be documented and implemented assessed at 83%.

Implemented but not documented assessed at 7%.

The lowest category not documented and not implemented was found to be 0.5%.

The analysis of the overall assessment findings ratings is summarised in Figure 8:

Figure 8. Overall assessment findings ratings



Notices issued

There were **37** compliance notices in total issued to **25** mines in relation to this assessment program.

The notices issued for structural collapse coal mines above surface were reviewed and Table 2 lists the notices issued by type and number.

Table 2: Notices issued for the planned inspection program – structural collapse coal mines above surface

NOTICE TYPE	TOTAL ISSUED	NUMBER OF MINES
s.23 notice of concerns	25	22
s.191 improvement notice	11	10
s.195 prohibition notices	1	1
Total	**37**	**25** **Note: some mines were issued multiple notices**

Recommendations

Based on the findings outlined in the report and with respect to the numbers and types of compliance notices issued during the program. Mine operators should consider the following recommendations:

- Review the site mechanical engineering control plan related to management of risk controls associated with traffic management and potential for impact damage on surface structures.
- Review the site mechanical engineering control plan related to the management of risk controls associated with overload conditions on surface structures and progressive weakening of the structure by wear, corrosion and fatigue.
- Review the site mechanical engineering control plan related to the management of risk controls associated with structural foundation degradation and natural events affecting the structural integrity of surface structures.

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 – Assessment criteria rating

Each assessed criteria is rated from 1 through 4 based on evidence supporting the expected control supports identified at the mine site:

Evidence supporting expected control supports.

Expected control supports	Rating	Evidence supporting rating / comments
	4 3 2 1	

Assessment findings results are calculated based on the total points allocated to the assessed ratings as a percentage of the maximum possible points for each criteria group, and any findings rated as 'Not applicable' were excluded from the calculation.

Criteria assessed ratings and points.

Assessed as	Rating	Points
Documented & implemented	4	4
Implemented but not documented	3	2
Documented but not implemented	2	1
Not documented and not implemented	1	0
Not applicable		

Findings results (points) with colours assigned as follows:

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