

## Consolidated report

# Mechanical engineering control plan – structural collapse – METEX mines above and below surface

March 2023 to February 2024



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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 TIER 1 surface and underground metalliferous and extractives mines (Metex sites) and the threats critical controls and control supports are identified in the mechanical engineering control plan structural collapse Metex sites bow tie.

Human exposure to structural collapse in surface and underground Metex mining environments has the potential to cause serious and/or fatal injuries to workers if not controlled effectively.

This report will consolidate assessment findings and provide analysis and recommendations for operators of Metex sites.

An inspection assessment program was developed to assess how well Metex sites are prepared to manage that risk.

In total there were 30 Metex sites assessed including:

- 20 open cut and quarry sites
- 2 processing sites
- 8 underground mines.

In summary, there were 990 individual assessment findings and of those 163 assessment findings required enforcement action to be taken at a Metex site.

The assessment program was conducted between March 2023 and February 2024.

In summary, there were 73 compliance notices in total issued to 28 of the 30 Metex sites assessed comprising of:

- 3 x section 195 prohibition notices issued
- 46 x section 191 improvement notices issued
- 24 x section 23 cause for concern notices issued

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

# Assessment criteria for all assessments

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

A tabulation of the threats, critical control and criteria for the review of the mechanical engineering control plan structural collapse at Metex sites is provided in Table 1.

Table 1. Threats, critical controls and criteria assessed for the review of the mechanical engineering control plan structural collapse at Metex sites

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

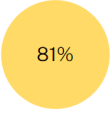
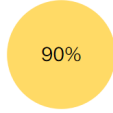
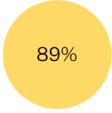
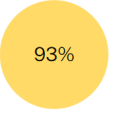
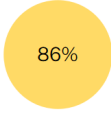
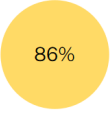
## Summary of assessment findings for Metex sites

In summary, the assessment findings for Metex sites were:

- 30 Metex site assessments comprised of:
  - 20 open cut and quarries
  - 2 processing sites
  - 8 underground Metex mines
- 990 individual findings for the assessed criteria
- 163 assessment findings with enforcement action recorded related to the management of the mechanical engineering control plan structural collapse at Metex sites.

Figure 1 provides a summary assessment of overall results of structural collapse by threat and critical control (criteria) at Metex surface and underground sites.

Figure 1. Summary assessment overall results of structural collapse by threat and critical control (criteria)

Threat					Grand Total
1. Impact damage 2. Overload 3. Progressive weakening of structure (wear, corrosion, fatigue) 4. Foundation degradation..	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	
					

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

In summary the overall assessment findings by threat and critical control (criteria) at Metex sites were assessed in total as 86%.

The lowest assessment critical control (criteria) finding was structural integrity which was assessed as 81%.

## Assessment of critical controls (criteria) at Metex sites

There were 5 critical controls (criteria) assessed for mechanical engineering control plan structural collapse at Metex sites including:

- structural integrity
- traffic management
- operate within design limits
- repair modification quality assurance
- corrosion protection.

In summary 5 out of 13 structural integrity critical control supports ranked in the orange colour range of greater than or equal to 65% and less than 80%.

The lowest ranked critical support number 12 was ranked 65%:

*Verify that plant and structure foundations are free from evidence of corrosion, impact damage, ore or stone build up or exposed steel reinforcing on any concrete foundation.*

The assessment of the critical control (criteria) structural integrity at the Metex sites assessed is provided in Figure 2.

Figure 2. Summary assessment findings of the critical control (criteria) structural integrity for Metex sites

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.	69%
		02	Verify that structural audits are completed at the specified frequency.	77%
		03	Confirm that structural audit reports are authorised by a Certified Practising Engineer (CPEng).	89%
		04	Confirm that routine inspection reports and structural audits are reviewed so that those accountable are aware of identified defects and required action.	83%
		05	Confirm the structural audit scope includes all plant and structures that could expose people to risk if they failed.	86%
		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.	92%
		07	Confirm that defects identified during inspections and structural audits are recorded and prioritised in a system for managing defects.	76%
		08	Confirm that the prioritised defects are rectified to schedule.	75%
		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.	86%
		10	Verify the mine process for managing change was applied to the changes that could impact the structural integrity of the plant or structure.	84%
		11	Verify that a vibration study has been completed and actions identified.	85%
		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.	65%
		13	Verify unused plant or structures are secured in a manner that prevents risk of harm to people.	95%
<b>Grand Total</b>				<b>81%</b>

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

In summary, all 3 traffic management critical control supports ranked in the yellow colour range of greater than or equal to 80% and less than 100%.

The lowest ranked critical support number 2 was ranked 86%:

*Confirm the specified traffic management controls are implemented*

The assessment of the critical control (criteria) traffic management at the Metex sites assessed is provided in Figure 3.

Figure 3. Summary assessment findings of the critical control (criteria) traffic management for Metex sites

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.	88%
		02	Confirm the specified traffic management controls are implemented.	86%
		03	Confirm supervisors and operators can explain the traffic management controls for mobile equipment operating in the vicinity of plant or structures.	98%
Grand Total				90%

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

In summary 1 out of 5 operate within design limits critical control supports ranked in the orange colour range of greater than or equal to 65% and less than 80%.

The lowest ranked critical support number 5 was ranked 76%:

*Confirm the work identified as being required to extend the life of plant and structures has been completed to allow for continued safe operation.*

The assessment of the critical control (criteria) operates within design limits at the Metex sites assessed is provided in Figure 4.



Figure 4. Summary assessment findings of the critical control (criteria) operates within design limits for Metex sites

Critical control number	Critical control	Control support number	Criteria Text	
PC 2.2	Operate within design limits	01	Confirm supervisors and operators can explain the traffic management controls for mobile equipment operating in the vicinity of plant or structures.	100%
			Verify that the load capacity of the plant and structures is known.	92%
		02	Confirm the specified load limiting controls are implemented.	96%
			Confirm supervisors and operators can explain the load limits and load limit controls for any operator-controlled plant and structure loading functions.	95%
		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...	83%
			Confirm the work identified as being required to extend the life of plant and structures has been completed to allow for continued safe operation.	76%
Grand Total				89%

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

In summary, all 4 repair modification quality assurance critical control supports ranked in the yellow colour range of greater than or equal to 80% and less than 100%.

The lowest ranked critical support number 4 was ranked 88%:

*Confirm the required repairs have been carried out and post work quality assurance has been completed.*

The assessment of the critical control (criteria) repair modification quality assurance at the Metex sites assessed is provided in Figure 5.

Figure 5. Summary assessment findings of the critical control (criteria) repair modification quality assurance for Metex sites

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.	95%
		02	Confirm the repair or modification procedures describe the: • Qualifications of people completing the repair or modification. • Material specifications...	94%
		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 ..	93%
		04	Confirm the required repairs have been carried out and post work quality assurance has been completed.	88%
Grand Total				93%

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

In summary, 1 out of 8 corrosion protection critical control supports ranked in the orange colour range of greater than or equal to 65% and less than 80%.

The lowest ranked critical support number 5 was ranked 78%:

*Confirm that spillage or waste material that may hold moisture is not accumulating against structural members.*

The assessment of the critical control (criteria) corrosion protection at the Metex sites assessed is provided in Figure 6.

Figure 6. Summary assessment findings of the critical control (criteria) corrosion protection for Metex sites

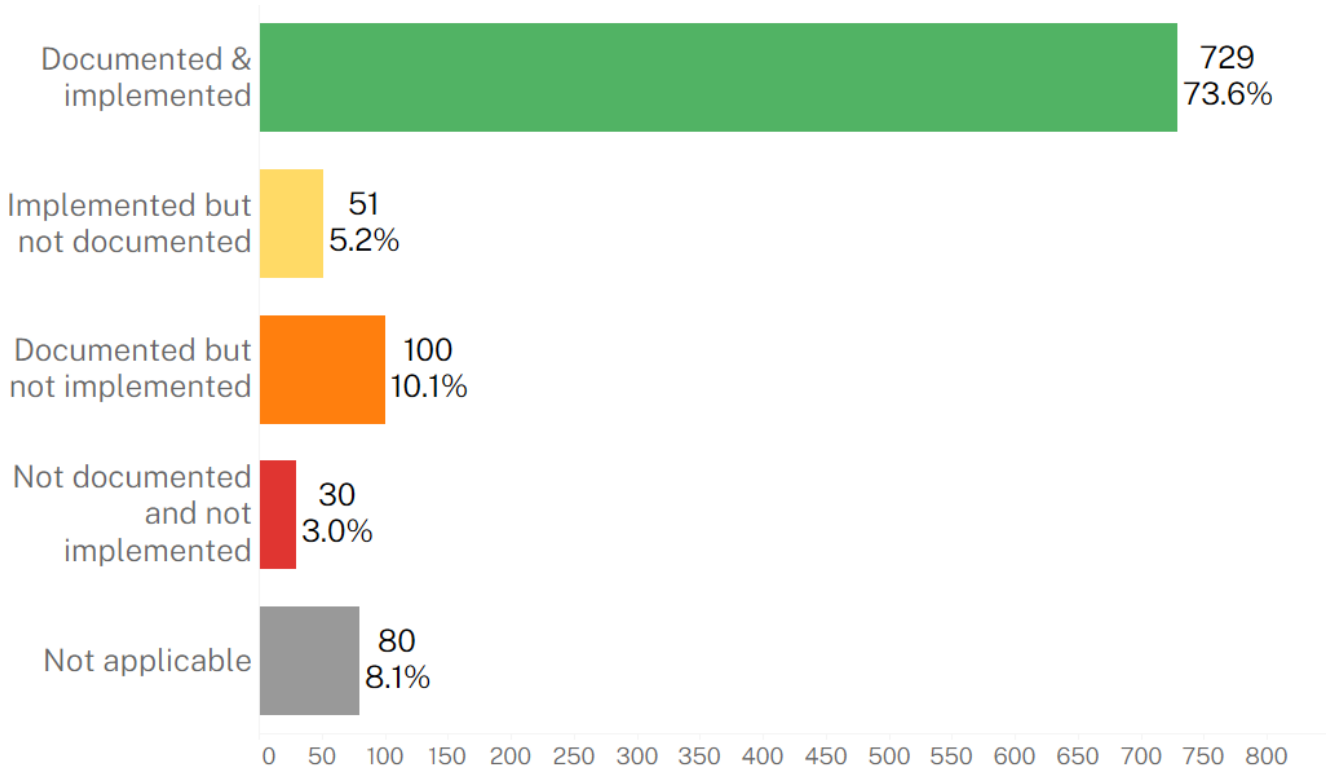
Critical control number	Critical control	Control support number	Criteria Text	
PC 3.2	Corrosion protection	01	Verify that containment vessels and structural materials in contact with corrosive substances are resistant to corrosion.	96%
		02	Confirm that leaks of corrosive substances are treated to prevent structural integrity impacts.	90%
		03	Verify that bimetal corrosion controls are visible and maintained.	93%
		04	Verify that water is prevented from pooling around structural members.	93%
		05	Confirm that spillage or waste material that may hold moisture is not accumulating against structural members.	78%
		06	Confirm the condition of plant or structures protective coatings is regularly inspected.	80%
		07	Confirm that protective coatings are maintained, for example by renewal.	80%
		08	Confirm the condition and effectiveness of protective coatings by visual inspection.	83%
Grand Total				86%

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

## Assessment findings – overall ratings

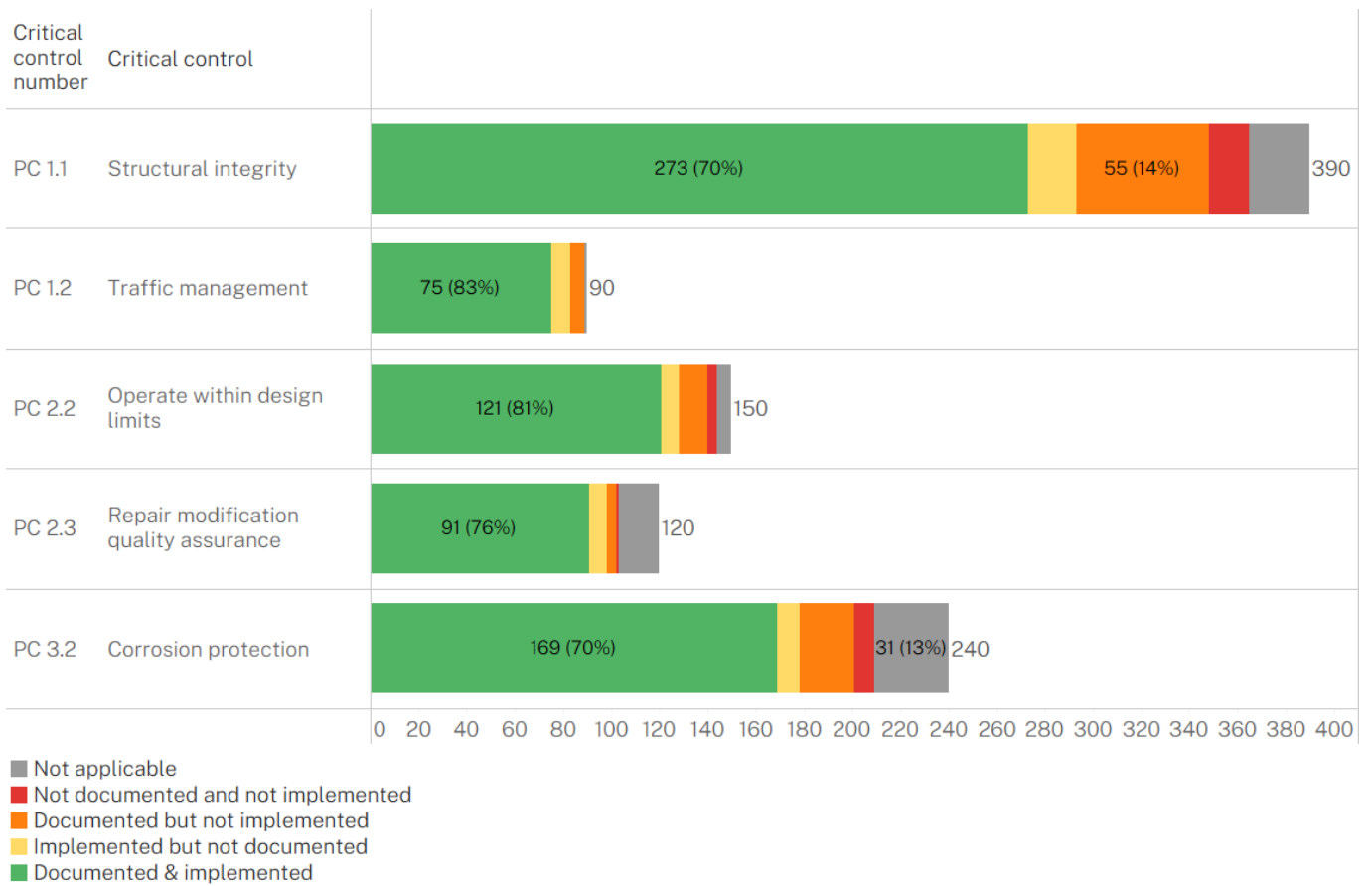
In summary, the overall assessment findings ratings for the mechanical engineering control plan – structural collapse at Metex sites is provided in Figure 7.

Figure 7. Overall assessment findings ratings at Metex sites



In review of the assessment findings ratings by critical control (criteria) at Metex sites is provided in Figure 8.

Figure 8. Overall assessment findings ratings by critical control (criteria)



## Notices issued to Metex sites

In summary, there were 990 individual assessment findings and of those 163 assessment findings required enforcement action to be taken at a Metex site between March 2023 and February 2024.

In summary, there were 73 compliance notices in total issued to 28 of the 30 Metex sites assessed comprising of:

- 3 x section 195 prohibition notices issued
- 46 x section 191 improvement notices issued
- 24 x section 23 cause for concern notices issued.

The compliance notices issued for Metex sites were reviewed and Table 2 lists the notices issued by type and number.

Table 2: Notices issued for Metex sites

NOTICE TYPE	TOTAL ISSUED	NUMBER OF SITES
s.195 improvement notice	3	3
s.191 improvement notice	46	24
s.23 cause for concern notice	24	24
<b>Total</b>	<b>73</b>	<b>28</b>

Note: some mine sites were issued multiple notices

## Recommendations for Metex sites

Based on the findings outlined in this report and with respect to the numbers and types of compliance notices issued during the assessment of the mechanical engineering control plans for structures at Metex sites.

The following recommendations should be reviewed by mine operators of Metex sites:

- Review structural integrity critical controls in particular:
  - verify structural integrity inspection and maintenance completed to schedule
  - verify structural audits are completed to the specified frequency
  - confirm identified defects are recorded and priority management assigned
  - confirm prioritised defects are rectified to the schedule
  - verify plant and structure foundations are free from corrosion, impact damage, material build up or exposed steel on concrete foundations
- Review operating within structural design limits critical controls in particular:
  - confirm the identified work to extend the life of the plant and structure has been completed to allow for continued safe operation
- Review corrosion protection critical controls in particular:
  - confirm that spillage or waste materials that may hold moisture are not accumulating against structural members.

## 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	<a href="mailto:cau@regional.nsw.gov.au">cau@regional.nsw.gov.au</a>
Incident reporting	To report an incident or injury call 1300 814 609 or log in to the <a href="#">Regulator Portal</a>
Website	<a href="http://www.resourcesregulator.nsw.gov.au">www.resourcesregulator.nsw.gov.au</a>
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				
	<table border="1"> <tr> <td>4</td> <td>3</td> </tr> <tr> <td>2</td> <td>1</td> </tr> </table>	4	3	2	1	
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 <b>Compliant</b>	4	4
Implemented but not documented <b>Improvement needed</b>	3	2
Documented but not implemented <b>Significant improvement needed</b>	2	1
Not documented and not implemented <b>Non compliant</b>	1	0
Not applicable (N/A)		

Findings results (points) with colours assigned as follows:

- Green (=100%)
- Yellow (>= 80% and <100%)
- Orange (>= 65% and <80%)
- Red (<65%)
- Not applicable