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Department of Regional NSW

Consolidated report

Falling objects – lifting and cranage – surface and underground coal mines -stage 1

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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, that is driven primarily from incident data as well as evolving industry trends. Although these topics may also be contained within the Resources Regulator 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.

This report summarises the planned inspection program assessment findings of review of critical controls related to falling objects occurring during lifting and cranage tasks at 36 surface coal mines and coal handling facilities conducted between May 2022 and January 2023. As a result of the assessment program there were 27 notices issued to 21 surface coal mines.

This report also includes the compliance priority program assessment findings of review of critical controls related to falling objects (lifting and cranage) for 16 underground coal mines conducted between June 2022 and November 2022. As a result of the assessment program there were 12 notices issued to 8 underground coal mines.

Background

Prior incidents in background to the development of the planned inspection program at surface coal mines included a fatality at a NSW surface coal mine in November 2018 involving a large tyre falling from a tyre handling forklift.

Industry information was published after a March 2022 fatality that occurred at a Queensland underground mine related to lifting work practices.

The Regulator identified increasing reportable incidents associated with lifting and cranage tasks during 2022 in the underground coal industry. In October 2022, several injury incidents causing injuries to workers during pulling and lifting tasks at NSW underground coal mines were addressed in a safety alert published by the Regulator.

As a result, the Regulator developed a compliance priority project targeted at specific issues related to lifting and cranage best practice in underground coal mines. This priority project program and the surface coal mine planned inspection program were run concurrently.

Scope

Falling objects is a hazard identified in the Regulator's mechanical engineering control plan (MECP) bowtie that can occur in a mining environment and has the potential to cause serious or fatal injuries if not controlled effectively.

The scope of the planned inspection program for surface coal mines targeted compliance with critical controls identified in the bowtie for:

- lifting plant stability and control
- lifting equipment integrity
- lifting practices
- exclusion zones.

The scope of the compliance priority program for underground coal mines included assessment of:

- lifting plant maintenance
- lifting equipment integrity
- lifting plant operation – competence of operators
- lifting practices – load characteristics
- lifting practices - procedures
- exclusion zones.

Objective

The intent of the planned inspection program and the compliance priority project is to gather data in relation to the industry's understanding of the controls for managing falling object hazards associated with lifting activities and their legal responsibilities to maintain a safe workplace.

Assessment criteria

Planned inspection program surface coal mines:

The Regulator has developed a bowtie hazard management framework and standardised assessment checklist for each program plan. Under each assessment 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.

An assessment program was developed to assess how mines are prepared to manage the risk.

For the planned inspection program for surface coal mines threats and critical controls are assessed for an unwanted event resulting from falling objects associated with lifting and cranage, these are shown in Figure 1.

Figure 1: Planned inspection program surface coal mines - threats and critical controls for the material unwanted event

THREAT	CRITICAL CONTROL
• Lifting equipment failure • Unstable ground (Environment?) • Intentional load movement	PC 2.1 – Lifting plant stability and control
• Lifting equipment failure	PC 2.2 – Lifting tackle integrity
• Lifting equipment failure • Unstable ground (Environment?) • Intentional load movement	PC 2.4 – Lifting practices

Compliance priority program for underground coal mines

For the compliance priority program for underground coal mines assessment criteria were identified as shown in Figure 2.

Figure 2: Compliance priority program criteria for underground coal mines

Criteria number	Criteria
01	Lifting plant maintenance
02	Lifting equipment integrity
03	Lifting plant operation
04	Lifting practices – load characteristics
05	Lifting practices – operating procedures
06	Exclusion zones

Key findings

Several common issues were identified in both programs, particularly in relation to site safety management systems, and the review of documentation highlighted the following:

Mechanical engineering control plan risk assessments:

- did not identify all mechanical hazards on site, including falling object risk
- lacked representative cross section of the workforce when identifying hazards and developing controls, and often no personnel involved in the risk assessment had lifting qualifications.
- lacked detail in the identifying falling object hazards and controls
- did not identify swing zone requirements as part of the exclusion zone definition
- provided no clear pathway to nominate controls for hazards identified in the MECP risk assessment. There were no references to subordinate documents to manage risk by identifying controls.

The majority of mine personnel assessed demonstrated:

- an understanding of the qualifications and authorisations required to perform lifting and slinging tasks
- they could identify lifting equipment and tackle inspections were completed, or tagged out and segregate equipment as defective for inspection, repair or replacement
- an understanding of how risks associated with falling objects were controlled, including drop zones or shadow zones as being no go or exclusion zones
- were effectively applying the mine's systems to manage hazards associated with lifting and cranage.

Some common issues across both programs related to the effective implementation of lifting systems including:

- Difficulty in differentiating the requirements for simple and complex lifts, or escalation protocols.
- Items of lifting tackle were not inspected, including slings, monorail trolleys, and lifting lugs.
- Lifting equipment was not stored correctly, covered in dirt, or left uncovered.

Planned inspection program surface coal mines assessments

An overall summary of the planned inspection program surface coal mines assessment findings is shown in Figure 3, and generally indicates on average a range of 80 to 100% level of compliance.

Figure 3. Planned inspection programs surface coal mines summary assessment findings overall results by threat and critical control

Threat			Grand Total
2. Lifting equipment failure 3. Unstable ground (Environment?) 4. Intentional load movement	2. Lifting equipment failure	2. Lifting equipment failure 3. Unstable ground (Environment?) 4. Intentional load movement	
PC2.1	PC2.2	PC2.4	
Lifting plant stability	Lifting tackle integrity	Lifting practices	
93%	94%	93%	93%

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

The following findings were identified in relation to the planned inspection program for surface mines and coal handling plants.

Critical control: PC 2.1 – Lifting plant stability and control

- Lack of mass markings.
- Working Load Limit (WLL) not displayed on lifting equipment.
- Lack of required labelling on hoists, vehicle mounted cranes, or lifting beams.

Critical control: PC 2.2 – Lifting tackle integrity

- Discard criteria not identified or understood.

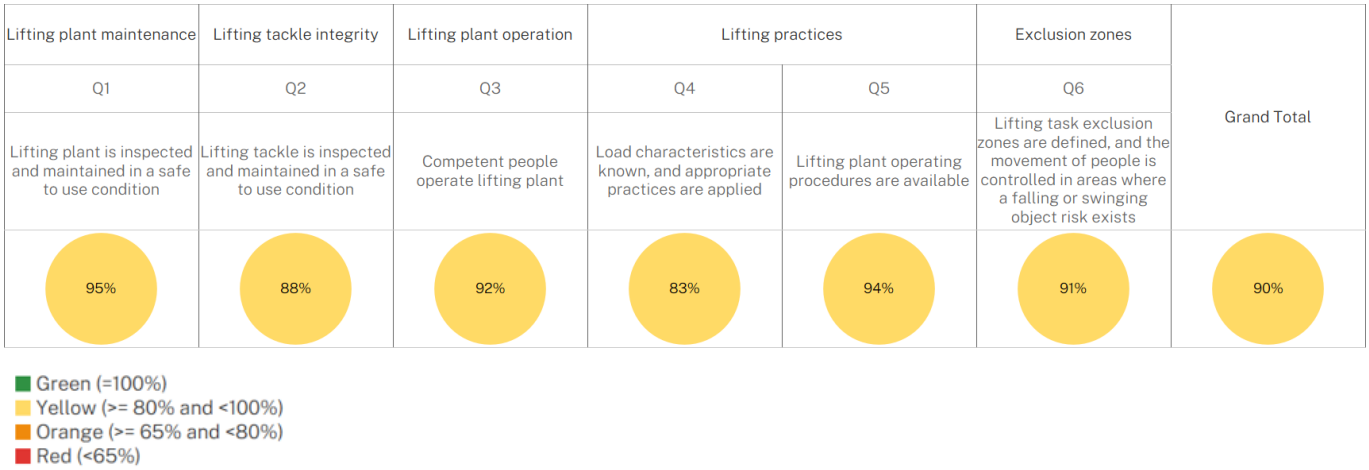
Critical control: PC 2.4 – Lifting practices

- Criteria for complex lifts.
- Pre-lifting assessment requirements, booklet unavailable for workers, or workers unsure on how to use them.
- Equipment not identified in maintenance and inspection system, including removal/lifting jigs.

Compliance priority project underground coal mine assessments

An overall summary of the planned inspection program surface coal mines assessment findings is shown in Figure 4, and generally indicates on average a range of 80 to 100% level of compliance.

Figure 4. Compliance priority project underground coal mines summary assessment findings overall results by criteria



The following key findings were identified in relation to the compliance priority program for underground coal mines.

Lifting plant maintenance

- Lack of collection areas for defective lifting equipment.
- Lifting equipment and tackle with out of date or missing tags.

Lifting tackle integrity

- CM cassette chains not included in lifting tackle inspection.
- Lifting beams not tagged or have no design/certification label.
- Lifting tackle not stored correctly, laying on floor, covered in grease/fines.

Lifting plant operation

- Beam clamp and lifting equipment attached to non-load rated beams without site assessing structural capacity.

Lifting practices

- No identification of swing hazard, tag colour scheme, transition time for tag inspections, lifting gear register.
- Identifying what is a simple, routine, or complex lift.

Exclusion zones

- Lack of identification of swing zones during lifts.
- Generally, barricade tape rib to rib with information tag to control access by personnel not involved in lifting job.

Notices issued

Planned inspection program surface coal mines notices

Of the 36 sites assessed under the inspection program, 21 separate mines were given 27 notices relating to the principal hazard of (falling objects expose people to harm – lifting and cranage), 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 (falling objects expose people to harm – lifting and cranage) are detailed in Figure 5. listing the notices issued by type and number of mines.

Figure 5. Notices issued for the planned inspection program surface coal mines – falling objects expose people to harm – lifting and cranage – stage 1

NOTICE TYPE	TOTAL ISSUED	NUMBER OF MINES
s.195 prohibition notice	-	-
s.191 improvement notice	10	9
s.23 notice of concerns	17	17
Total	**27**	**21**

Of the combined 27 notices issued, there were some common themes that were apparent throughout the program plan. Figure 6 summarises the type of contraventions.

These themes can be related to the critical controls and identify some trends of concern.

Figure 6. surface coal mines notices issued - categories of concern

IDENTIFIED CONCERN CATEGORY
Improvement notice:

- Control plan risk assessment:
  - did not involve a representative cross section of the workforce
  - did not identify all mechanical hazards on site, including the risk of being struck by falling objects from a belt conveyor
  - did not identify controls to effectively manage identified hazards
  - did not identify the requirement for swing zones as part of exclusion and drop zones
  - did not identify safeguards inclusive of interlocks, dead-man, two handed controls, etc
- MECP identified falls by people, but not falling objects that may injure people
- Standards of Engineering Practice (SEP) for lifting did not identify:
  - the competency requirements for simple lifts or equipment pre use inspections
  - the inspection schedules for lifting equipment such as chain blocks and lever hoists
  - did not identify swing zones as a consideration in exclusion or no-go zones
- Workers did not understand:
  - the different requirements for a simple or complex lift
  - criteria for a critical lift
  - or did not use, pre lift inspections or checklists

IDENTIFIED CONCERN CATEGORY
• Less than adequate standard of competence and authorisation records in relation to lifting qualifications • Out of date or missing equipment inspection tags, or equipment not inspected • Lifting equipment not marked with working load limit (WLL) • Lack of guidance on lifting equipment / tackle discard criteria
Notice of concern:
• Personnel in risk assessments did not have relevant lifting qualifications • Incomplete awareness by workers and supervisors, or lack of guidance on: — what constitutes a complex or a simple lift — escalation process when moving from a simple to a complex lift — identifying where exclusion zones should extend to — what assistance can be provided to a certified dogger / rigger — current lifting equipment tag colour • No system for storing completed documents in relation to complex lifts • SEP for lifting did not identify — drop zones did not identify exclusion and swing zones — inspection tag colour system or transition timing — that tackle used for towing could no longer be used for lifting • Lifting equipment or tackle: — did not appear to have an installers plate, identification plate, or load rating, such as truck mounted crane, vehicle hoists, or vehicle stands — not captured in the site maintenance and inspection system or lifting equipment register, such as jigs and lifting beams — had not been inspected or tagged — management systems did not include requirement to be supplied to Australian or relevant international standards — lack of guidance on discard criteria — defective equipment not stored in quarantine basket or have out of service tag — poor storage standards or exposure to the elements — unknown registration status of workshop overhead cranes with capacity greater than 10t • Completed inspection sheets had not been processed • Inconsistent use of pre lift checklist • Lack of mass marking on items that are required to be lifted • Lack of appropriate access warning signage on crane access platforms and walkways • Poor standards for guarding for falling object protection, entanglement, pinch and nip points • Defects not recorded in prestart inspection • Forklift defects relating to condition of tynes, tyres, hoses, lights, and operators' cabins

Compliance priority program underground coal mines notices

During the assessment program that required enforcement action, resulting in 12 notices being issued on 8 underground coal mines, consisting of 6 Improvement Notices, and 6 Notices of Concern.

The notices issued for (falling objects – lifting and cranage) are detailed in Figure 7. listing the notices issued by type and number of mines.

Figure 7. Notices issued for the compliance priority program underground coal mines – falling objects lifting and cranage

NOTICE TYPE	TOTAL ISSUED	NUMBER OF MINES
s.195 prohibition notice	-	-
s.191 improvement notice	6	4
s.23 notice of concerns	6	7
Total	**12**	**8**

Of the combined 12 notices issued, there were some common themes that were apparent throughout the program plan. Figure 8. summarises the type of contraventions.

Table 8. Underground coal mines notices issued categories of concern

IDENTIFIED CONCERN CATEGORY
s.191 Improvement Notices:
Mechanical Engineering Control Plan (MECP) Risk assessment: — was structured as a legislative compliance document, rather than identifying fundamental hazards and their associated effective controls — does not appear to identify site specific hazards and the mechanisms required to control them — falling objects, or introduce controls such as barricades, exclusion zones, signage, etc. — safeguards inclusive of interlocks, dead-man, two handed controls, etc — were out of review date MECP did not identify: — the controls to manage the hazards identified in the risk assessment — the correct referencing — safeguarding such as interlocks, dead-man switches, and two-handed controls SEP lifting and cranage: — still in draft — did not identify requirements for slings or chains — did not identify exclusion zones for swing radius Site not maintaining a site lifting gear register Procedures not in place for routine lifting tasks Personnel information has not been updated in the training matrix
s.23 Notice of concerns:
Training needs matrix failed to identify expired skills of workers, including dogging high risk license

IDENTIFIED CONCERN CATEGORY
Some workers had difficulty: — What defines a simple, routine, or a complex lift — identifying the current lifting equipment tag colour, — identifying where exclusion zones should extend to, — when and what assistance can be provided to a certified dogger/rigger. No clearly marked area for storing defective or untagged lifting equipment / tackle. No identification of current lifting tag colour in workshops. Out of date or missing equipment inspection tags. Out of date lifting tag colour signs. Lifting tackle had not been identified as requiring inspection (lifting beams, conveyor LTU shackles, CM bolt pod lifting chains, etc). Lifting tackle not stored correctly (left on the floor, covered in fines/spillage, in the yard/rain/sun). CHPP flooring with mesh did not address — Load rating for the attachment of lifting beam clamps — Objects dropping through the mesh — Spillage falling from one level to another In service monorails had no WLL indication, or disused monorails still had WLL. No falling object protection on forklift.

Recommendations

Mine operators should consider the following recommendations:

- Lifting, slinging, and craneage systems take into consideration exclusion, drop, and swing zones and the applicable aspects of recent incidents.
- Supervisors and workers are trained in lifting, load transfer, and towing, including identification and control of simple and complex lifts, and discard criteria for lifting tackle.
- Supervisors are trained in contractor and risk management.
- Risk assessments to include the interaction between different work groups.
- When planning tasks, workers must be supplied with relevant information, such as component weights and task procedures, to safely conduct the task.
- Implementation of robust permitting systems to manage lifting tasks.
- Supervisors confirm workers understand the tasks and steps required to safely complete tasks.
- When equipment is introduced to site, it should be inspected to confirm that any required risk control measures are fitted and available to workers.
- Pre-use inspections of lifting equipment such as cranes, monorails, chain blocks, lever hoists, forklifts, and telehandlers should include function testing and confirmation of current inspection tagging.
- Before removing or installing components, procedures include hold points when lifting or chocking must be in place to secure loads.
- Workers and supervisors entering work areas during lifting must remain clear of suspended loads.

- Tag lines to be used to control loads during lifting activities where workers are required in proximity to the load to guide it into place.

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 hazard (falling objects expose people to harm – lifting and cranage)

The following is a list of certain legislative requirements for the management of falling objects 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 Regulation 2017
    - Clause 5 Definitions
    - Part 3.2 Division 10 Falling objects, Clauses 54 and 55
    - Part 4.4 Falls, Clauses 78 to 80
    - Part 4.5 High risk work
    - Chapter 5
        - Part 5.1 General duties for plant and structures, including Clauses 214, 218, and 219
        - Part 5.2 Additional duties relating to registered plant and plant designs, including Clause 235
    - Schedule 3 High risk work licenses and classes of high-risk work
    - Schedule 4 High risk work licenses – competency requirements
    - Schedule 5 Registration of plant and plant designs
- Work Health and Safety (Mines and Petroleum Sites) Regulation 2022
    - Section 190 (1) (e) the fall or release from a height of plant, a substance or a thing,
    - Schedule 2 (2) Mechanical engineering control plan, specifically (4) (b)
- General Guide for Cranes - Safe Work Australia
- AS 1418 Series – Cranes including hoists and winches
- AS 2550 Series – Cranes – safe use
- AS 4991 – Lifting devices
- Resources Regulator publication including codes of practice, safety alerts, incident information releases, and incident reports

Published date	Reference	Title
February 2023 (1st published 2016)	NSW Code of Practice	Mechanical Engineering Control Plan (*WHSMPS legislation*)
November 2022	IIR22-05	Worker seriously injured using a crowbar to push a securing pin on a dozer counterweight during a lifting operation
October 2022	SA22-04	Dangers of lifting and pulling activities revealed
February 2021	IIR21-02	Drift winder head sheave pulley wheel falls from height during winder rope removal

Published date	Reference	Title
July 2020	IIR20-09	Worker injured while conducting repairs to mobile jaw crusher
June 2020	Investigation report	Report into the death of Quinton Moore at Bengalla mine 3 November 2018
June 2020	SA20-06	QDS pods fall off dolly car flat top and slide down drift
August 2019	Code of practice	Managing the risks of plant in the workplace
November 2018	IIR18-11	Tyre handler fatality
May 2017	SA17-04	Synthetic fibre sling fails

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 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 1: 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 2: 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.