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Regulator**

PLANNED INSPECTION PROGRAM

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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.

To this end, we 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.

This report summarises assessment findings from 41 mines in relation to assessments for the hazard of entanglement conducted during the period from February 2021 to June 2021.

The threats, consequences and critical controls assessed for the material unwanted event of entanglement are shown in Table 1. Note that not all critical controls were applicable at all mines.

Table 1: Threats, Consequence and Critical Controls for the Material Unwanted Event – Entanglement – Coal Mines

	THREAT/CONSEQUENCE	CRITICAL CONTROL
Threat	1. Engagement with moving parts	PC1.1 – Equipment safeguarding
		PC1.2 – Safe-standing zones
	2. Unexpected movement of machine parts	PC2.2 – Isolation standards
Consequence	1. Physical trauma fatality	MC1.2 – Emergency stops

Legislative requirements and published guidance relating to the hazard of entanglement are listed in Appendix A. Figures 1 - 3 present safety compliance findings for each de-identified mine and critical control assessed for the material unwanted event of entanglement. Explanatory notes on the assessment system are also listed in Appendix B.

Key Findings

Regulatory compliance action was required at a number of sites due to various contraventions of the relevant legislation. One site required immediate intervention and was issued a prohibition notice under section 195 of the *Work Health and Safety Act 2011*, with respect to:

- Poor underpass guarding where workers could become exposed to the return belting and rollers.
- The off-walk side of the conveyors do not have a pull wire system for stopping the conveyor. The signage and barriers to prevent access was inadequate.
- Some recently installed guarding structures are affixed together with electrical zip ties.
- Inadequate guarding around exposed return tracking roller.

Numerous statutory notices were issued under section 191 of the *Work Health and Safety Act 2011* and section 23 of the *Work Health and Safety (Mines and Petroleum Sites) Act 2013*. Significant issues were identified across a number of sites in relation to the mechanical and electrical control plan risk assessments, associated control plans and supporting documents. These include:

- Risk assessments and control plans were not current.
- Risk assessments had general lists of hazards, rather than identifying the specific hazards related to the site. This was often the case when the control plan risk assessments were managed by a corporate office and risk assessments attended by a number of sites.
- Risk assessments incorrectly identified the absence of a control as being a hazard.
- Risk assessments did not nominate controls to specifically, and effectively, mitigate the identified hazard.
- The identification of potential hazards and controls was left to workers performing the task, with no guidance from overarching documents and risk assessments on the range of hazards that may reasonably be encountered.
- Risk assessments did not identify the risk of entanglement.
- Risk assessments did not have an adequate cross-section of the site workforce, including site safety and health representatives (SSHR).

- Where the control plan format is a directory document, there is no clear hierarchical structure to the subordinate documents to manage potential conflict between similar documents.

In addition, it was identified that:

- There was no documented requirement for safeguarding of machinery, which includes guards, interlocks, two-handed controls, and dead man's switches.
- There was no documented requirement for emergency stops that identify the placement, design, and functionality of e-stops, machine stops, and hydraulic stops.
- Recently introduced mode indicator lighting in development panels did consider colours used at other mines, either within their own company or the wider industry.
- 'No-go zone' documents could not be practically applied. They did not identify zone requirements for all plant, such as around feeder breakers when the hopper chain is still running, and the shuttle car has moved away. Similarly, they required a person in one safe-standing zone to reach through a no-go zone to operate equipment in another safe zone.
- Staff were not included in training related to no-go zones and other entanglement controls.
- Conveyor emergency stop lanyards were missing, were behind or above guards, had no droppers in high roof areas, were not secured at an accessible height, or were not secured at all.
- Poor housekeeping standards including build-up of coal fines, spillage and accumulation of float dust, as well as other flammable and combustible material such as grease and oils, timber, cardboard.

Although many sites nominated AS4024.3611 for their guarding standard around conveyors, and site audits were completed on guarding standards, they failed to identify areas where guarding standards were considered to be inadequate by inspectors, including:

- Guarding standards were not identified for equipment other than conveyors.
- No risk assessment was done to determine guarding design types to be implemented as required in the AS4024 series of standards, including AS4024.1601 and AS4024.3611.
- Guarding or access covers were inadequately secured, or did not require a tool to remove, such as missing bolts, loose bolts that could be undone by hand, over-centre toggles, or cable ties.

- Guarding did not prevent access to nip, pinch, and shear points, especially:
 - conveyor boot ends, load stations, scrapers, ploughs, and self-tracking frames
 - flexible conveyor train (FCT) crawling chain
 - CHPP centrifuge baskets, rotary breakers, pump shafts, magnetic separator drums, or filter press pulleys.
- Side and end barriers were not present or inadequate to prevent personnel walking into, or ducking under, elevated conveyor structures that was less than 2.7 metres above floor level.
- Guarding or handrails was absent, or less than 1 metre above floor/stair height, or had build-up of spillage in walkway, alongside equipment such as hoppers, conveyors, vibrating screens, or underpans that would not prevent a person falling into the equipment.
- Temporary guarding, especially during conveyor guarding upgrades, did not adequately prevent access to nip, pinch and shear points.

Recommendations

Mine operators should ensure a comprehensive site-based risk assessment for the mechanical and electrical engineering control plan is conducted by a team of participants that are suitably qualified and experienced. The risk assessment should, so far as reasonably practicable:

- identify all hazards on site related to entanglement
- identify all effective controls to be implemented to satisfactorily mitigate the risk, or reduce it to as low as reasonably practicable (as per hierarchy of controls)
- include a cross-section of the operations workforce, including the site safety and health representative(s)
- outline the relevant components of the safety management system which address the risk and detail the implementation of the associated controls
- incorporate any feedback or recommendations from assessments or audits which have been conducted by subject matter experts

- where an engineering control has a critical control function, such as safeguarding, isolation points, and emergency stops, the design, functionality, placement, maintenance, and verification requirements should be documented
- where an administrative control has a critical control function, such as safe-standing and no-go zones, then requirements for accessibility to the document/procedure, manner of display, training content/frequency, practical assessment, and verification process should be included in the document/procedure.

Mine operators should also ensure that appropriate resources are made available to adequately manage entanglement risks, as well as to validate and verify the effectiveness of controls. These processes should be regularly reviewed to not only confirm compliance, but also identify any deficiencies which may exist. As part of this, defined review periods should be implemented as part of a mature safety management system, and also clearly outline what triggers a review outside of these nominated timelines (e.g. a notifiable incident).

It is recommended that mine operators, upon reading this report, review their site's relevant risk assessment, principal control plans, and associated documents, to manage the risks associated with entanglement that are unique to their site. During the review process, mine operators are also encouraged to consider the above recommendations, as well as the guidance published within Appendix A, as a minimum.

Introduction

The NSW Resources Regulator's planned assessment programs provide a planned, risk-based and proactive approach to assessing how effective an operation is when it comes to controlling critical risk. These programs apply the following principles:

- a focus on managing prescribed 'principal hazards' from the Work Health and Safety (Mines & Petroleum Sites) Regulation 2014
- evaluation of the effectiveness of control measures implemented through an organisation's safety management system and
- consideration of the operation's risk profile.

The objective of risk profiling is to identify the inherent hazards and the hazard burden that exist at individual operations in each mining sector in NSW. The information is then used to develop the operational assessment and inspection plans that inform the program.

Scope

Planned inspection programs include two assessment types:

- Targeted assessments, incorporating:
 - desktop assessment of:
 - compliance against legislation with respect to the management of health and safety risks associated with entanglement – see Appendix A for details
 - the definition of the controls the mine utilises to prevent and mitigate the risks to health and safety associated with entanglement.
 - a workplace assessment of the implementation of those controls through the inspection of plant and worker interviews.
- Planned assessments, which involve a workplace assessment of the implementation of controls through the inspection of plant and worker interviews only.

The process

The process for undertaking an assessment under a planned inspection program generally involves the following stages:

- preliminary team meetings, preparation and review of documents
- execution of an on-site assessment involving:
 - an on-site desktop assessment of relevant plans and processes measuring legislative compliance of the relevant plans (targeted assessments only)
 - the inspection of relevant site operations (both targeted assessments and planned inspections).
- discussion and feedback to the mine management team on the findings and actions that need to be taken by the mine operators in response.

Assessment findings

Threats, consequences and controls assessed

Threat:

- Engagement with moving parts

Critical control: PC 1.1 – Equipment safeguarding.

Control objective: Guards prevent people accessing entanglement hazards.

Performance requirement:

- entanglement hazards are identified
- access to entanglement hazards is prevented by equipment safeguarding.

When designing, purchasing, or overhauling equipment, mine and plant operators must ensure that safeguarding standards for equipment have been considered, assessed, implemented, inspected and maintained. The operation should have documented requirements for safeguarding that includes acceptability criteria for guards, interlocks, two-handed controls, dead man's devices, as well as a verification process for assessing their ongoing effectiveness.

The documentation should nominate:

- the standard used to control the hazard, such as the AS4024 series compliance standards or equivalent
- risk assessment of the site hazards requiring safeguards to determine the types of safeguards to be applied
- inspection requirement and frequency, as well as acceptability criteria
- maintenance requirements and process for defect rectification
- training requirements for those inspecting and maintaining safeguards
- verification process to validate effectiveness standards for safeguards are being adhered to.

With regard to this specific critical control, the following issues were identified throughout the planned inspection program:

- No documented standards for safeguarding of machinery, (e.g. guards, interlocks, two handed controls, dead man’s switches).
- Guarding standards were not identified for equipment other than conveyors.
- A risk assessment was not completed to determine guarding design types to be implemented as required in the AS4024 series of standards, including AS4024.1601 and AS4024.3611.
- Guarding or access covers were inadequately secured, or did not require a tool to be removed, such as missing bolts, loose bolts that could be undone by hand, over-centre toggles, or cable ties.
- Guarding did not prevent access to nip, pinch, and shear points, especially:
 - conveyor boot ends, load stations, fixed skirting, scrapers, ploughs, and self-tracking frames
 - flexible conveyor train (FCT) crawling chain
 - CHPP centrifuge baskets, rotary breakers, pump shafts, magnetic separator drums, vibrating screens, or filter press pulleys.
- Side and end barriers were not present or inadequate to prevent personnel from walking into, or ducking under, elevated conveyors located less than 2.7 metres above floor level, or where conveyor structure transitions from floor to roof.
- Guarding or handrails were absent, or less than 1 metre above floor/stair height or had build-up of spillage in walkway, alongside equipment such as hoppers, conveyors, vibrating screens, or underpans. This spillage negated the protection offered by the guard or handrail that prevented a person from falling into the equipment.
- Temporary guarding, especially during conveyor guarding upgrades, that did not adequately prevent access to nip, pinch and shear points.
- Significant items of steelwork installed at inbye and outbye ends of load stations to mount guards may constitute fixed steelwork requiring guarding.

Critical control: PC 1.2 – Safe-standing zones.

Control objective: People remain a safe distance from unguarded entanglement hazards.

Performance requirement:

- entanglement hazards are identified
- people comply with safe-standing zone requirements.

When developing standards and procedures for safe-standing zones, the mine operator should consider the following:

- Identification of equipment at the site where entanglement hazards cannot be effectively mitigated by hard barriers, either due to the nature of the hazard, or the operational requirements of the plant, and that management of proximity to the hazard is a practical and effective control.
- Requirements for access to the document/procedure, manner of display, training content/frequency, practical assessment, and verification process should be included in the document/procedure.

With regard to this specific critical control, the following issues were identified throughout the planned inspection program:

- No-go zone documents could not be practically applied either because they did not identify zone requirements for all plant, such as around feeder breakers when the hopper chain is still running and the shuttle car has moved away. Or they required a person in one safe-standing zone to reach through a no-go zone to operate equipment in another safe zone.
- Staff were not included in training related to no-go zones and other entanglement controls.
- Lack of access to, or superseded version of, no-go zone and isolation documents in mining panels.
- Mode lighting on plant did not appear to have an industry standard. Continuous miners observed to have red light for cutting/tramming, green or yellow light for bolting mode, green to signal the shuttle car is okay to approach. Unexpected movement of machine parts

Critical control: PC 2.2 – Isolation standards.

Control objective: Prevent equipment starting while people are working near entanglement hazards.

Performance requirement:

- entanglement hazards are identified
- plant cannot start when people are working near entanglement hazards
- prevent equipment starting while people are working near entanglement hazards.

When designing, purchasing, or overhauling equipment, mine and plant operators must ensure that isolation standards for equipment have been considered, assessed, implemented, inspected and maintained. The operation should have a site standard for isolation that includes permit system, personal isolation equipment, general site isolation equipment, dissipation of energy, lock-out devices, as well as a verification process for their ongoing effectiveness.

The standard should nominate:

- the standard to be applied
- methods of isolation
- tools required for isolation (e.g. personal/equipment/isolator locks, multi-clasp, lock box, lock station, permits).
- requirements for:
 - locations of access to the document/procedure
 - manner of display
 - training content/frequency
 - practical assessment
 - verification process.

With regard to this specific critical control, the following issues were identified throughout the planned inspection program:

- lack of access to, or superseded version of, no-go zone and isolation documents in panels
- lack of signage identifying hazards such as ‘isolate elsewhere before removing guard’, ‘shuttle car wheeling road’, ‘do not access this area’
- lack of barricades or permits when performing live testing of equipment

- no isolation procedures in service folders
- poor recording of active group isolations
- labels on plant items do not correspond to those on the isolation panel.

Consequence:

- **Physical trauma fatality**

Critical control: MC 1.2 – Emergency stops.

Control objective: Enable stopping of the plant in the event a worker becomes entangled.

Performance requirement:

- entanglement hazards are identified
- emergency stops are available and ready for use in the event of an entanglement.

All plant and equipment used on site, whether fixed, mobile, permanent or hired, shall have a method of effectively stopping its operation in the event of an emergency. There are many types of stop controls used in the mining industry that can be used in the event of an emergency, including machine stop buttons, hydraulic stop buttons, conveyor lanyards, and e-stops.

The operation should have a site standard for emergency stops that includes what is the functionality of an acceptable emergency stop, where they should be located, as well as a verification process for their ongoing effectiveness. The standard should include the following:

- conduct a risk-based assessment on the design, functionality, and placement of stop controls
- nominate the requirements and operational standards to be applied
- inspection and testing requirement and their frequency
- maintenance requirements and management process while defects are rectified
- training requirements for those inspecting and maintaining nominated emergency stops
- verification process to validate effectiveness standards for e-stops are being maintained.

With regard to this specific critical control, the following issues were identified throughout the planned inspection program:

- No documented requirements for emergency stops that identify the placement, design, and functionality of e-stops, machine stops, and hydraulic stops.
- Splash guards placed over e-stops, or placing e-stops within an enclosure, instead of on the outside of the enclosure, make them difficult to identify and activate in an emergency.
- No signage to identify button as an emergency stop.
- Use of local control stations for equipment that have multiple coloured buttons of various designs, not necessarily mushroom shaped.
- Multiple machine stops in an area make it difficult to determine which button to use to stop an item or items of equipment in the event of an emergency, especially when labels on machines did not match the labels on the local control station.

Findings by mine

Figures 1 - 3 present aggregate assessment findings by 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 if both elements were assessed as present. More details explaining the assessment system are found at Appendix B.

Figure 1: Assessment findings for the planned inspection program – entanglement – coal mines – overall results < 90%

	Threat			Consequence
	1. Engagement with moving parts		2. Unexpected movement of machine parts	1. Physical trauma fatality
	PC1.1	PC1.2	PC2.2	MC1.2
	Equipment safeguarding	Safe standing zones	Isolation standards	Emergency stops
Mine A	Red	Green	Yellow	Orange
Mine B	Red	Orange	Green	Yellow
Mine C	Red	Green	Green	Red
Mine D	Red	Green	Yellow	Yellow
Mine E	Red	Green	Green	Yellow
Mine F	Red	Green	Orange	Green
Mine G	Orange	Green	Green	Red
Mine H	Red	Yellow	Green	Green
Mine I	Yellow	Yellow	Yellow	Green
Mine J	Red	Green	Yellow	Green
Mine K	Red	Green	Green	Yellow
Mine L	Red	Green	Green	Yellow

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

Figure 2: Assessment findings for the planned inspection program – entanglement – coal mines – overall results ≥ 90% and < 100%

	Threat			Consequence
	1. Engagement with moving parts		2. Unexpected movement of machine parts	1. Physical trauma fatality
	PC1.1	PC1.2	PC2.2	MC1.2
	Equipment safeguarding	Safe standing zones	Isolation standards	Emergency stops
Mine M				
Mine N				
Mine O				
Mine P				
Mine Q				
Mine R				
Mine S				
Mine T				
Mine U				
Mine V				
Mine W				
Mine X				
Mine Y				
Mine Z				
Mine AA				
Mine AB				

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

Figure 3: Assessment findings for the planned inspection program – entanglement – coal mines – overall results = 100%

	Threat			Consequence
	1. Engagement with moving parts		2. Unexpected movement of machine parts	1. Physical trauma fatality
	PC1.1	PC1.2	PC2.2	MC1.2
	Equipment safeguarding	Safe standing zones	Isolation standards	Emergency stops
Mine AC	●	●	●	●
Mine AD	●	●	●	●
Mine AE	●	●	●	●
Mine AF	●	●	●	●
Mine AG	●	●	●	●
Mine AH	●	●	●	●
Mine AI	●	●	●	●
Mine AJ	●	●	●	●
Mine AK	●	●	●	●
Mine AL	●	●	●	●
Mine AM	●	●	●	●
Mine AN	●	●	●	●
Mine AO	●	●	●	●

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

Notices issued

Of the 41 sites assessed under the inspection program, 38 separate mines and coal handling plants received notices relating to the hazard of entanglement, while some received notices in relation to other matters. For the purposes of this report, contraventions related to other matters have been removed from the analysis. The notices issued for entanglement 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 – entanglement - coal mines

NOTICE TYPE	TOTAL ISSUED	NUMBER OF MINES / CHPP'S
s.195 prohibition notice	2	1
s.191 improvement notice	35	21
s.23 notice of concerns	43	33
Total	80	38

Of the combined 80 notices issued, there were some common themes which were apparent throughout the program plan. Table 3 summarises the common contravention themes that were encountered. These themes can be related back to the critical controls outlined earlier and identify some trends which are of concern.

Table 3: Notices issued - prevalence of categories of concern

IDENTIFIED CONCERN CATEGORY

Risk assessments had general lists of hazards, rather than identifying the specific hazards related to the site.

Risk assessments incorrectly identified the absence of a control as being a hazard

Risk assessments did not nominate controls to specifically, and effectively, mitigate the identified hazard

Risk assessments did not have an adequate cross-section of the site workforce, including site safety and health representatives (SSHR)

No documented requirements for safeguarding of machinery that included guards, interlocks, two-handed controls, dead man’s switches

No documented requirements for emergency stops that identify the placement, design, and functionality of e-stops, machine stops, and hydraulic stops

Conveyor emergency stop lanyards were missing, behind/above guards, had no droppers in high roof areas, were not secured at an accessible height, or were not secured at all

Guarding standards were not identified for equipment other than conveyors

No risk assessment was done to determine guarding design types to be implemented as required in the AS4024 series of standards, including AS4024.1601 and AS4024.3611

Guarding or handrails were either not installed, not adequately secured, or did not prevent access to nip, pinch and shear points

Further information

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

CONTACT TYPE	CONTACT DETAILS
Email	cau@planning.nsw.gov.au
Incident reporting	To report an incident or injury call 1300 814 609 or log in to the Regulator Portal
Website	https://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 hazard entanglement

The following is a list of certain legislative requirements for the management of entanglement risks referred to in this report, as provided by the Work Health and Safety (Mines and Petroleum Sites) Regulation 2014 and Work Health and Safety Regulation 2017.

Work Health and Safety Regulation 2017:

- Clause 208 - Guarding
- Clause 191 - Emergency stop controls
- Clause 211 - Emergency stops
 - (1) If plant at a workplace is designed to be operated or attended by more than 1 person and more than 1 emergency stop control is fitted, the person with management or control of plant at the workplace must ensure that the multiple emergency stop controls are of the “stop and lock off” type so that the plant cannot be restarted after an emergency stop control has been used unless that emergency stop control is reset.
 - (2) If the design of plant at a workplace includes an emergency stop control, the person with management or control of the plant at the workplace must ensure that:
 - (a) the stop control is prominent, clearly and durably marked and immediately accessible to each operator of the plant
 - (b) any handle, bar or push button associated with the stop control is coloured red
 - (c) the stop control cannot be adversely affected by electrical or electronic circuit malfunction.

Work Health and Safety (Mines and Petroleum Sites) Regulation 2014:

- Clause 44A - Operation of belt conveyors

- (2a) must ensure that all belts conveyors are fitted with an emergency stop system.
- Schedule 2 - Mechanical engineering control plan:
 - (1) The operator of a mine or petroleum site must, in preparing a mechanical engineering control plan, take the following into account in determining the means by which the operator will manage the risks to health and safety from the mechanical aspects of plant and structures at the mine or petroleum site:
 - (b) the reliability of safeguards used at the mine or petroleum site to protect persons from the hazards posed by the plant or structure during each phase of its life cycle.
 - (2) A mechanical engineering control plan must set out the control measures for the following risks to health and safety associated with the mechanical aspects of plant and structures at the mine or petroleum site taking into account the matters set out in subclause (3):
 - (a) injury to persons caused by the operation of plant or by working on plant or structures
 - (c) the unintended operation of plant.
 - (3) The following matters must be taken into account when developing a control measure referred to in subclause (2):
 - (d) safe work systems for persons dealing with plant or structures including the isolation, dissipation and control of all mechanical energy sources from plant or structures.

Appendix B. Assessment system explained

We use 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 in accordance with the ICMM handbook. Only controls deemed critical¹ 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.

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

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 $\geq 80\%$ but $< 100\%$ of possible points	Yellow
An assessment result of $\geq 65\%$ but $< 80\%$ of possible points	Orange
An assessment result of $< 65\%$ of possible points	Red