Rio Tinto

D1 Underground Safety

HSE-B-20

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Managing Director Group Technical	Chief Technical Officer	All Rio Tinto managed underground studies, operations and projects, including closure

Direct linkages to other relevant policies, standards, procedures or guidance notes:

- Rio Tinto Health, safety, environment and communities policy (HSEC-A-01)
- Rio Tinto Management system standard (HSEC-B-01)
- Rio Tinto Risk management policy (RIS-A-001)
- Rio Tinto Risk management standard (RIS-B-001)
- Rio Tinto C Safety Standards
- Rio Tinto D3 Management of slope geotechnical hazards (HSE-B-024)
- Rio Tinto D5 Management of tailings and water storage facilities standard (HSE-B-23)
- Rio Tinto D7 Functional Safety standard (HSE-B-31)
- Business Resilience and Recovery Programme (HSE-C-23)
- Rio Tinto Underground Mobile Equipment Specifications Group Procedure (HSE-C-042)
- Rio Tinto Underground fire risk assessment Group Procedure (HSE-C-043)
- Rio Tinto Underground Emergency Management Group Procedure (HSE-C-044)
- Rio Tinto Underground fixed plant fire prevention and control Group Procedure (HSE-C-045)
- Rio Tinto Underground refuge chamber Group Procedure (HSE-C-046)
- Rio Tinto Ground control management Group Procedure (HSE-C-047)
- Rio Tinto Inflow or inundation of liquids management Group Procedure (HSE-C-048)
- Rio Tinto In-rush of solids management Group Procedure (HSE-C-049)
- Rio Tinto Air blast and surface subsidence management Group Procedure (HSE-C-050)
- Rio Tinto Hoisting and Shaft Sinking Group Procedure (HSE-C-051)
- Rio Tinto Application of C Safety Standards in the Underground Group Procedure (HSE-B-052)
- Rio Tinto D1 Operational controls Group Procedure (HSE-C-053)
- Rio Tinto Management of Underground Mine Ventilation Group Procedure (HSE-C-054)
- Rio Tinto C Safety Standard Guidance notes
- Rio Tinto D1 Standard Guidance notes
- Rio Tinto Development of Trigger Action Response Plans leading practice guideline
- Rio Tinto Projects – Study definitions guidance note (RTPR-PMT-GND-0005)

Document purpose:

This Standard provides Auditors, Nominated Managers and Qualified Individual/s, details on what must be achieved to comply with D1 Standards and associated D1 Group Procedures in the Underground environment. It applies to all Rio Tinto managed underground studies, projects, and operations, as outlined in the Scope of the D1 Underground Safety Standard.

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D1 Underground Safety

1. Purpose

The D1 Underground Safety Standard describes the minimum requirements that must be implemented in all underground operations, projects and studies, as outlined in the Scope, to minimise potential exposure of personnel to underground major hazards. It must be applied in conjunction with the D1 Group Procedures that provide further clarity on the detailed requirements.

2. Scope

This Standard applies to all Rio Tinto managed operations, projects and studies where underground excavations exist or are planned, including:

a) Mine design and procurement of equipment
b) Existing sites and acquisitions
c) Exploration and evaluation projects, through all development phases
d) Project development and construction through to operation
e) Operation through to closure
f) Post-closure management

An Underground Excavation is defined as a human-made void constructed below ground, including where the rock mass around the void is considered stable without ground support or where ground support elements are installed to assist to support the rock mass.

Where an engineered structure is built below ground and not directly connected to an underground excavation (for example, cut and cover constructions), this Standard will not apply. The controls for design of, and access to these structures must be aligned with recognised engineering standards and the Rio Tinto safety performance standard C5-Confined Spaces.

Historic Underground Workings are considered human-made excavations and the requirements of the D1 Standard apply.

A natural underground feature (commonly referred to as a cave) is not human made and this Standard is not intended to be applied to safely enter these environments. Where work is required to be performed in a cave the considerations listed in Appendix A: Control requirements to access natural underground features – caves, must be applied.

The level of effort required to demonstrate compliance with this Standard is mandated by the D1 Group Procedures and guided by the D1 Guidance Notes.

All requirements outlined in this Standard are management requirements and are therefore assured through the Rio Tinto Integrated Assurance processes.

The management of explosives is covered in the C8 Explosives standard HSEC-B-30.

3. Planning and Design

The D1 standard must be read in conjunction with the Rio Tinto group procedures for:

a) Ground control management (HSE-C-047)
b) Inflow or inundation of liquid management (HSE-C-048)
c) In-rush of solids management (HSE-C-049)
d) Air blast and surface subsidence management (HSE-C-050)
e) Underground Emergency Management (HSE-C-044)
f) Underground fire risk assessment (HSE-C-043)
g) Underground mobile equipment specifications (HSE-C-042)
h) Underground fixed plant fire prevention and control (HSE-C-045)
i) Underground refuge chamber (HSE-C-046)
j) Management of Underground Mine Ventilation (HSE-C-054)
k) Application of C Standards in the Underground (HSE-C-052)
l) Hoisting and Shaft Sinking (HSE-C-051)
m) D1 Underground Operational Controls (HSE-C-053)

Where the term, 'the Group Procedures' is used in this Standard, this is in reference to the procedures listed above.

3.1 Each project or asset that has underground excavations where people work must appoint a Nominated Manager who is accountable for the implementation of this Standard and who shall review and approve the documents associated with section 3.3 Risk Assessment, and section 3.4 Management Plans and safe work procedures.

3.2 The appointed Nominated Manager must ensure that there are sufficient Qualified Individuals assigned to implement this Standard.

3.3 Risk Assessment

A risk assessment must be undertaken in accordance with the Group Procedures, where there is potential for harm to persons, that identifies and evaluates sources of risk and is reviewed and approved, as a minimum, on an annual basis:

a) Falls of ground, rock/strain burst or collapse
b) Inflow or inundation of liquids
c) In-rush of solids
d) Air blast
e) Surface subsidence
f) Potential emergency situations
g) Underground fire events
h) Potential hazardous atmosphere and harmful effects from them
i) Shaft sinking
j) Hoisting operations
k) High-risk activities / tasks underground that have potential for major consequence outcomes for personnel working underground

3.4 Management plans and safe work procedures

The following control documents (management plans or safe work procedures) shall be developed where the risk assessments identify the potential for harm to persons:

a) Ground Control Management Plan
b) Inflow or Inundation of Liquids Management Plan
c) In-rush of Solids Management Plan
d) Air Blast Management Plan
e) Subsidence Management Plan
f) Emergency Response Plan
g) Fire Control Plan
h) Ventilation Management Plan
i) Shaft Management Plan that includes sections for
    i. Shaft sinking
    ii. Hoisting
    iii. Rope management
    iv. Hoisting & Conveyance safety systems
    v. Maintenance, Inspections & Testing
j) Safe work procedures that outline minimum control measures required for the management of the risk associated with operational high-risk tasks

The management plans / safe work procedures shall:

3.4.1 Be designed by a Qualified Individual(s)

3.4.2 Incorporate the following information and controls:

a) As required by the Group Procedures as referred to in this Standard
b) Controls identified through the risk assessments
c) Regional legislative requirements

3.4.3 Document the triggers for a formal management of change process in accordance with the Rio Tinto Management System standard – Element 11.

3.4.4 Be reviewed every two years or more frequently as determined by risk assessment, event or when there is a material change to the mine plan or operating conditions.

3.5 A mine design and approval process must be established to ensure that no mining is undertaken without an approved mine design.

3.6 A three-dimensional geotechnical domain model for the orebody and host rock must be established and maintained throughout the life of the project and operation.

3.7 All design work required in the Group Procedures must be completed and undertaken by a Qualified Individual(s) including studies and independent reviews.

3.8 The Emergency Response Plan shall (As detailed in Element 12 of the Rio Tinto Management system standard and Underground Emergency Management Group Procedure (HSE-C-044):

a) Identify the potential of emergency situations and their duration.
b) Provide written procedures developed in response to the identified potential emergency situations

3.9 The Fire Control Plan shall:

a) Apply fire prevention and mitigation control to the design, placement, and operation of infrastructure / plant, fuel, combustibles, and explosive materials storage areas.
b) Establish a system for the installation, inspection, and maintenance of fire detection, warning, and suppression systems.
c) Provide for real-time carbon monoxide monitoring in major ventilation circuits of the mine including the associated TARPs.
d) Establish fire response capabilities available at all times when people are underground. This will

include First Responders capability achieved through annual training for all underground personnel to recognise and respond where appropriate, through to specific Mines Rescue capability.

e) Designate all underground areas as “No Smoking”, including the use of electronic cigarettes.
f) Identify prohibited items and establish a system to prevent these items entering underground areas.
g) Include the requirement for self-contained self-rescuers (SCSR) with a minimum capacity of 30-minute oxygen supply.
h) Provide for caches of additional SCSR, determined by a risk assessment.

3.10 A Qualified Individual or group must design and commission the following systems as set out in Underground fixed plant fire prevention and control procedure (HSE-C-045) and in Underground Mobile Equipment Specifications Group Procedure (HSE-C-042):

a) Fixed and portable fire detection.
b) Warning.
c) Suppression.
d) Alarms; and
e) Equipment.

3.11 The Ventilation Management Plan shall, as set out in Management of Underground Mine Ventilation Group Procedure (HSE-C-054):

a) Specify a ventilation system that provides a sufficient volume, velocity, and quality of air to prevent hazardous atmospheres
b) Provide for real-time carbon monoxide monitoring in major ventilation circuits of the mine
c) Establish a programme of inspection and maintenance of the ventilation system
d) Establish a programme of periodic monitoring and testing of the ventilation system carried out by a competent person or group
e) Incorporate a Trigger action response plan (TARP) prescribing the pre- planned response to escalating levels of risk for explosive gases, thermal stresses, toxic and asphyxiating gases
f) Establish a system of monitoring for potentially harmful or explosive gases and dust that is designed by a competent person or group

3.12 A Qualified Individual(s) must design shaft infrastructure, work stages, conveyances and/or hoisting equipment or design any modifications to these as required in the Hoisting and Shaft Sinking Group Procedure (HSE-C-051). An independent Qualified Individual(s) must review designs prior to construction or installation.

4. Implementation and Operation

4.1 The following must be established, as set out in the Group Procedures:

a) Safe work procedures to support the implementation of this Standard
b) A formal, competency-based training programme for underground personnel, that includes:
    i. General hazard awareness training, refreshed at a frequency not exceeding two years
    ii. Training to undertake specialist activities
c) A system to maintain records for all aspects of this Standard
d) A communication process for the transfer of information between technical and operations personnel

4.2 A process must be established to ensure that personnel work and / or travel under supported ground, or under secured ground where the ground control strategy does not require the installation of ground support.

4.3 The design (or selection) of equipment and machinery used for specialist activities where there is a risk of exposure of personnel to ground failure, must meet the requirements of section 4.3 of the Ground control management group procedure (HSE-C-047).

4.4 Excavation methods must incorporate controls to reduce the risk of over-break and/or undesired damage to the rock mass surrounding the excavation, as outlined in section 4.4 of the Ground control management group procedure (HSE-C-047).

4.5 The Emergency Response plan must incorporate the involvement of the in-house mine rescue teams, third party mine rescue teams (where available) and the use of local emergency services, to provide adequate capacity for the duration of the identified potential emergency situations. The mines rescue teams shall be trained and resourced to respond to emergencies as identified in risk assessment and in compliance with the requirements set out in the Underground Emergency Management Group Procedure (HSE-C-044).

4.6 Each underground operation must have an effective system, together with at least one independent backup system, to warn all personnel in the underground operation, that an emergency situation exists.

4.7 Location of Refuge Chambers and Fresh Air Bases must include the following in conjunction with the Underground refuge chamber Group Procedure (HSE-C-046) and Underground Emergency Management Group Procedure (HSE-C-044):

a) The capacity of self-contained self-rescuers (SCSRs) used in the underground operations,
b) The potential for flooding, inrush and inundation,
c) Thermal extremes and evacuation routes.
d) Clear and highly visible signs must be used to demarcate all evacuation routes.

4.8 Secondary Egress shall be established as soon as practicable during development before production commences. Each operation must establish and maintain evacuation routes including secondary egress as close as practicable to existing and planned working areas.

4.9 All persons who work in the underground operations must have annual training in emergency response, or more frequently as operational activities necessitate, in what to do in the event of an emergency.

4.10 All equipment used underground, must be incorporate the controls to manage risk of fire, determined by a risk assessment and in accordance with relevant Group procedures:

a) Underground Mobile Equipment Specifications Group Procedure (HSE-C-042)
b) Underground fixed plant fire prevention and control Group Procedure (HSE-C-045)

4.11 Where there is a risk of fire from flammable and combustible materials, the following controls must be implemented:

a) Flammable and combustible materials are isolated from ignition sources
b) Storage of flammable liquids, combustible materials or explosives shall not be in a location where fumes or fire can affect decline portal, shaft, adit or ventilation intakes.

4.12 Where the risk of fire from hot work exists, hot work procedures and permit systems must be implemented.

4.13 Petrol (gasoline) powered equipment must not be permitted underground.

4.14 Where likelihood for spontaneous combustion of in situ materials exists, a Spontaneous combustion management plan must be implemented.

4.15 Where there is a risk of accumulation of harmful levels of gases or potential for explosive atmospheres, the following controls must be implemented:

a) Underground personnel must be trained in the recognition of signs, indicators, and hazards of mine gases
b) Underground personnel must be trained in preventive measures and emergency procedures
c) Where the potential for a combustible dust explosion exists, there must be the means to minimise propagation of an explosion

4.16 The C Safety Standards must be complied with in the underground environment. Where it is impossible or impracticable to achieve compliance the intent of the Standard must be implemented as detailed in the Application of C Standards in the Underground Group Procedure (HSE-C-052). The aim of this procedure is to:

a) Clarify expectations of the C Safety Standards
b) Outline additional requirements over and above the expectations of the C Safety Standards; and
c) Include the alternate controls to apply C Safety Standards

4.17 Hoisting and shaft sinking control systems must comply with the Rio Tinto D7 Functional Safety Standard HSE-B-31

4.18 All conveyances used for personnel transport must meet the requirements as per the Hoisting and Shaft Sinking Group Procedure (HSE-C-051). As a minimum must

a) Be fully enclosed
b) Be provided with secondary egress throughout the entire travel way should the primary conveyance become inoperable
c) Have two independent means of communication throughout the entire travel way with the hoist operator.
d) Be provided with an emergency braking mechanism that will stop the conveyance from free falling in the event of a rope or rope attachment failure unless:
    i. Conveyances suspended by two or more head ropes and attachments are not required to be fitted with an emergency braking mechanism.
    ii. During shaft sinking, shaft equipping, shaft maintenance, shaft rehabilitation, shaft refurnishing and/or applications where a risk assessment determines this mechanism cannot be fitted

4.19 Any rope and/or attachments used as part of the hoisting system or shaft sinking operation must meet the requirements as per the Hoisting and Shaft Sinking (HSE-C-051) Group Procedure.

4.20 All hoisting and/or shaft sinking operations shall implement a scheduled maintenance programme that meets the requirements as per the Hoisting and Shaft Sinking (HSE-C-051) Group Procedure. As a minimum must include:

a) Manufacturer's specifications
b) Maintenance strategy and tactics, including the management of low-frequency failure modes and associated protective systems
c) Computer Maintenance Management System

4.21 Persons who design, operate, inspect, maintain, or test any part of the hoisting system or shaft sinking operation must be a Qualified Individual as per the Hoisting and Shaft Sinking Group Procedure (HSE-C-051).

4.22 In shaft sinking operations, work methods must eliminate interaction with people and machinery on the shaft bench during mucking.

4.23 Work practices for hoisting and/or shaft sinking operations must prevent injuries and fatalities from persons and objects falling from height. Work is to be conducted on separate levels only if on the same task with the appropriate controls within the headframe through to shaft bottom.

5. Monitoring

5.1 Monitoring, inspection and QA/QC programmes must be established for the hazards identified in the risk assessments and in accordance with the requirements of the Group Procedures

5.2 The design of monitoring systems must meet the requirements set out in the Group Procedures.

5.3 The collection, analysis, evaluation and reporting of data from monitoring, inspection and QA/QC programmes must be undertaken by a Qualified Individual(s).

5.4 Trigger Action Response Plans (TARPs) must be developed when identified by the risk assessments and as required by the Group Procedures, they must incorporate trigger conditions for the monitoring, inspection and QA/QC programmes.

5.5 Communication protocols between management and those carrying out maintenance and inspections must be established to ensure the timely notification of adverse findings.

5.6 Independent reviews of the hoisting and shaft sinking operations must be conducted by a Qualified Individual or group. The frequency of independent operations reviews must not be less than once every two years. The reviewer(s) must complete and sign the record of inspection.

6. Definitions

Item name	Definition
3D Geotechnical Domain Model	A three-dimensional spatial model of the orebody and host rock that includes regions with similar rock mass characteristics (geology, structure, hydrogeology and geotechnical parameters) and which are therefore expected to exhibit a similar rock mass response due to mining
Air Blast (Event)	The rapid flow of air through an underground opening following compression of the air in a confined space, caused by mining activities, at or exceeding a threshold velocity of 20 m/s
Control System	A control system manages, commands, directs, or regulates the behaviour of other devices or systems using control loops for safe operations
Conveyance	A generic term that includes cages (for personnel and materials), skips/kibbles (for mineral or waste rock), counterweights, inspection cages (for maintenance) and 'skeletons' (for e.g. pipe transport) that are hoisted through the shaft.
Dust explosions	The rapid combustion of suspended dust particles in air which may expand through the mine openings due to the generation of intense heat and pressure.

Evacuation Routes	The defined travel ways that have been identified as safe ways to escape from an underground mine in the event of an emergency; they are usually highlighted on plans and maps as well as being positively identified with signage in the underground workings.
Explosive	(In reference to a gas) A mixture of gases that undergoes a chemical change reaction leading to a rapid increase in volume when ignited.
Explosives	Solid or liquid Chemical substances that undergo a rapid chemical change producing large volumes of gas when ignited.

Fresh Air Bases (FAB)	A fresh air base is, as the name implies, a base at which good respirable air has been established. It can be the point of departure for the mine rescue team, and no one should proceed beyond the fresh air base unless they have respiratory protection apparatus with them. The fresh air base must have an assured supply of good air at all times. In choosing the base, consideration should be given to providing the following:
	• The travel way from the base to surface must always be assured of good air (preferably intake air).
	• Constant underground to surface communication.
	• Other things that could be considered:
	  ○ A clean area with good lighting.
	  ○ An assembly area for servicing breathing apparatus.
	  ○ An area for briefing and debriefing mine rescue teams.
	• If the base is located underground, consideration should also be given to the following points:
	  ○ Necessary tools and supplies to carry out the work at hand
	  ○ First aid equipment and supplies

Functional Safety	Part of the overall safety of a system or piece of equipment that depends on automatic protection operating correctly in response to its inputs or failure in a predictable manner (fail-safe).
Geotechnical Domain	Regions of ground with similar rock mass characteristics and which are therefore expected to exhibit a similar rock mass response due to mining
Ground	A term used as a reference for the soil, or rock mass, and support elements surrounding an underground excavation, including the bottom, top and sides
Ground Failure (event)	Also referred to as a *fall of ground (event)* or *collapse*, is any uncontrolled release and/or fall of soil, rock or installed ground support material from the rock mass around an excavation, that causes, or has the potential to cause, harm to people, damage to equipment or production delays
Hazardous Atmosphere	Atmosphere that is harmful or irrespirable to people.
Headframe	A structure, including its footings, at the top of a shaft designed to withstand the loads in a hoisting system, including impact loads from an overwind and which supports the conveyance guides above the shaft collar as well as the loading and unloading facilities
Historic Underground Workings	These are underground excavations that were constructed previously and if entered then the D1 Underground Safety Standard must be applied

Hot Work	Hot work is any process that can be a source of ignition when flammable material is present or can be a fire hazard regardless of the presence of flammable material in the workplace. Refers to welding, soldering, heating, cutting, grinding or vulcanising in which the surface temperature of the work or a tool for the work is likely to exceed 150°C
Independent Means of Communication	A back up communication system that share no components with the primary communication system, including UPS
Independent Review	A review undertaken by a Qualified Individual(s) that is sufficiently removed from the day-to-day operation of the site to maintain independence and objectivity, to avoid a conflict of interest
Independent Risk Assessment Facilitator	A person engaged to implement the risk assessment process, who will not be engaged in the day-to-day application of risk assessment outcomes, remaining neutral and maintaining consistent application of the risk analysis process and inclusive participation. This person must be trained in the risk assessment process
Inflow or Inundation of Liquids Event	The sudden and uncontrolled inflow of liquids into underground workings that causes, or has potential to cause harm to people, damage to equipment or production delays
In-rush of Solids Event	A sudden, unplanned and uncontrolled inflow of dry or liquefied solids into an underground opening
Mucking	The process of removing broken rock or ore from a mine excavation (development drive or the bottom of the shaft)
Multi-Purpose Refuge Chambers	Refuge Chamber that are used for other functions (offices, meal rooms, etc.) and are not exclusively dedicated as a Refuge Chamber only. These are commonly a permanent Refuge Chamber but can also be a portable Refuge Chamber.
Nominated Manager **(Area Manager)**	The nominated person(s) responsible for the implementation of each technical risk area of the D1 standard, who is formally appointed by the Site Senior Leader. This person(s) must be certified as qualified by the Site Senior Leader as being able to fulfil this role
Over-break	A term used to describe/quantify the unplanned and unintended removal of excess rock mass material from the perimeter of an excavation during its development, resulting in the designed geometry of the excavation being exceeded
Permanent Refuge Chamber	A refuge chamber that partly utilises surrounding strata to form part of the hermetically sealed enclosure of an operational Refuge Chamber. This type of Refuge Chamber is constructed and cannot be relocated
Portable Refuge Chamber	A sealed, freestanding and sturdy (usually metal) enclosure with all the required equipment to be a functional Refuge Chamber and is placed in an underground excavation. This type of refuge chamber is designed to be relocated when it becomes obsolete in that area and is required elsewhere. This type of Refuge Chamber does not utilise surrounding strata to provide a hermetically sealed enclosure during the operation of the Refuge Chamber in an emergency.
Primary Egress	The route identified as the first means of exiting the mine or work area to a safe location (surface, fresh air base, refuge chamber or CABA storage location) in the event of an emergency that will provide the fastest and safest means of escape.

Qualified Individual	Is someone who has acquired, through training, qualifications, experience or a combination of these, the knowledge and skill enabling the person to perform particular tasks and duties to the standard of performance expected in the workplace
Quality Assurance	The maintenance of a desired level of quality in a service or product, especially by means of attention to every stage of the process of production, delivery and usage
Quality Control	A system for verifying that a product or service meets specifications and user requirements
Rope Attachment	A generic term for all the components used to attach a shaft rope or winch rope to a conveyance, Galloway or work stage, or a fixed structure such as the headframe. It includes capels, sockets, pins, links, chase blocks, draw bars.
Secondary Egress	The route identified as the second preference of exiting the mine or work area to a safe location (surface, fresh air base, refuge chamber or CABA storage location), if the primary egress of exiting the mine becomes blocked or is deemed unsafe to use in the event of an emergency situation.
Secured Ground	Ground that has been evaluated (includes checks of excavation stability) by a Qualified Individual and deemed safe to enter for a specific task and duration
Self-Contained Self Rescuer (SCSR)	A portable oxygen source for providing breathable air when the surrounding atmosphere lacks oxygen or is contaminated with toxic gases (e.g., carbon monoxide, methane). A SCSR is usually a closed-circuit breathing apparatus with a chemical oxygen generator or a compressed oxygen cylinder and a carbon dioxide absorber. Capacity of SCSR is measured against European Standard EN13794n
Shaft Infrastructure	The equipment in an underground mine which includes the motors, transmission equipment, headframe, sheaves, ropes, shaft, shaft conveyances, shaft sinking equipment, shaft furnishings, hoist controls, counterweight, signalling and communications equipment and any other equipment used in connection with a hoist
Shaft Management Plan	A formal procedure that provides information on how a site manages known D1 related Major Hazards via controls assessed by risk assessments and should include; • Nominated manager for the standard • Design – Identify hazard and risk assessment • Implementation and operation – Risk control • Monitoring and verification • Roles and responsibilities • Training requirements The Shaft Management Plan shall comprise of; I. Shaft sinking II. Hoisting III. Rope management IV. Hoisting & Conveyance safety systems V. Maintenance, Inspections & Testing
Shaft Rope	A head rope, tail, balance, guide or rubbing rope in permanent installation and a hoisting rope for shaft sinking hoist
Shaft Sinking Equipment	Systems used during shaft sinking which include, shaft sinking hoist and bucket, winch, winch rope, Galloway, work stage or platform, and operated as such until preliminary shaft development shaft equipping is completed

Shaft Sinking Hoist	The drum hoist used during shaft sinking. This hoist may be the permanent hoist. The term is used to distinguish between the operation of a hoist and its ropes during shaft sinking operations and their use as a permanent installation
Site Senior Leader	The site General Manager, or equivalent (example – registered site manager), that is accountable for the appointment of Nominated Managers to the D1 standard
Spontaneous combustion	The exothermic reaction of carbonaceous materials when exposed to oxygen over time, resulting in the generation of heat.
Supported Ground	Ground that has been secured and fully supported to the required standard documented in the Ground Control Management Plan
Surface Subsidence	The lowering of the ground surface in response to underground mining
Trigger Action Response Plan (TARP)	A plan for immediate implementation that lists the hazardous conditions which initiate a response and the resulting actions required from those persons listed with roles and responsibilities in the plan
Underground Excavation	A human-made void constructed below ground, including where the rock mass around the void is considered stable without ground support or where ground support elements are installed to assist to support the rock mass.
Unsupported Ground	Ground that has not been supported to the required standard documented in the Ground Control Management Plan
Velocity	The rate of change of position and direction of movement of air, usually expressed in direction and speed in metres per second (m/s).
Winch (or Stage) Rope	A rope used to support a work stage or platform used during shaft sinking, shaft repairs, maintenance and other shaft work or a raise, ore bin or other application.
Workstage or Platform	A support structure that is suspended and moveable and is used to lift or lower a worker who is performing work in a shaft during shaft sinking, shaft repairs, maintenance and other shaft work or a raise, bin, or other application at an underground mine.

7. References

Rio Tinto Risk management standard, RIS-B-001

Rio Tinto *Management system standard, HSEC-B-01*

Accessible via Rio Tinto Group HSESC information Hub

- Rio Tinto *Underground Mobile Equipment Specifications Group Procedure* (HSE-C-042)
- Rio Tinto *Underground fire risk assessment Group Procedure* (HSE-C-043)
- Rio Tinto *Underground Emergency Management Group Procedure* (HSE-C-044)
- Rio Tinto *Underground fixed plant fire prevention and control Group Procedure* (HSE-C-045)
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- Rio Tinto *Air blast and surface subsidence management Group Procedure* (HSE-C-050)
- Rio Tinto *Hoisting and Shaft Sinking Group Procedure* (HSE-C-051)
- Rio Tinto *Application of C Safety Standards in the Underground Group Procedure* (HSE-B-052)
- Rio Tinto D1 *Operational controls Group Procedure* (HSE-C-053)
- Rio Tinto *Management of Underground Mine Ventilation Group Procedure* (HSE-C-054)

Rio Tinto *Leading Practice Guideline – Development of Trigger Action Response Plans*. Accessible via Rio Tinto Group HSESC information Hub

Rio Tinto Projects *Study definitions guidance note, RTPR-PMT-GND-0005*. Accessible via Element

Rio Tinto *D1 Nominated manager letter templates*. Accessible via the Underground Mining Technical Library SharePoint.

Rio Tinto *HSEC standards D1 Nominated Manager training modules*, Accessible via Prospect

Rio Tinto *HSEC D1 training modules*, Accessible via Prospect

Rio Tinto internal document source locations:

- Element: Policy hub > Policy hub: Group policies, standards & procedures
- RT Group HSESC Information Hub
- Underground Mining Knowledge Hub

Appendix A Control requirements to access natural underground features - caves

Caves have been formed by the forces of nature over long periods of time and require different controls and assessment techniques than those human-made excavations. Prior to any person entering or working in a cave a detailed Risk Assessment is required with the following key considerations as a minimum:

a) Is Personal access required? Can the work be performed without any person entering the cave? The use of technology to achieve this should be rigorously reviewed.

b) Geotechnical assessment of the cave by a suitably qualified person to ensure stability of the cave

c) Ventilation and testing requirements to ensure the atmosphere is not harmful to persons entering the cave, including consideration for atmospheric and biological contaminants that may be present

d) Safe access and egress with a plan for how to recover a person in an emergency event

e) Potential for flooding of the cave from a sudden inrush of water

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Document control

File Name	
Description	
Original Author(s)	
Creation Date	
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Risk Ranking	Assessment Date	Risk Assessor	Review Schedule	Next Review Date
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