

PNR-000069, Rev.06: 05/04/2022

Department Issuer: Health, Safety and Operational Risks

Technical Responsible: Occupational Safety and Geographic Support Management

Target Audience: All professionals who act in Health, Safety and Operational Risk in Vale

Training Needed: () YES (x) NO

Expected Results:

- ✓ To develop and improve existing requirements focusing on the pillar “Zero Lives Lost and Zero Lives Changed”;
- ✓ To consolidate the Critical Activities Requirements as a high-level document and global standard for application throughout Vale in all its business and processes;

Association with VPS:



Purpose

To establish minimum requirements for performing critical activities in order to preserve people's lives.

Application

This document applies to Vale at a global level and must be adopted by its subsidiaries or entities where, by shareholders' agreement, Vale is responsible for health and safety management.

Important Definitions

- **Short term occasional access:** Uncertain and/or casual event, related to an urgent/emergency, where there is no prediction of recurrence.
- **Critical Activity:** Activity that presents risks with potential to generate fatality or lives changed.
- **Mining Area:** Mineral exploration and waste disposal area including machinery, equipment, accessories, installations and civil works used in surface or underground areas in which the industrial exploitation of the mineral deposit is carried out until processing. Administrative areas, cafeterias, accommodations, for example, are not considered mining areas.
- **Medical Contraindication:** Medical term used to characterize the prohibition of exposure to a hazard due to an individual health condition.

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- **Transitional Activity Limitation:** Individual health condition that temporarily restricts the performance of a critical activity by an individual. This condition must be reassessed after the restriction period determined by a certified doctor.
- **Qualified Professional:** Professional who has adequate experience and training to be considered competent to perform their duties in critical activities, considering relevant laws and internal guidelines.

Premises

This document establishes mandatory requirements that must be complied with in all areas and organizational processes, whether performed by Vale employees or by contractors, on the following subjects:

- CAR 01 - Working at heights
- CAR 02 - Light motor vehicles
- CAR 03 - Mobile equipment operation
- CAR 04 - Lockout, tagout and zero energy
- CAR 05 - Lifting of loads
- CAR 06 - Confined spaces
- CAR 07 - Machine guarding
- CAR 08 - Activities on the ground
- CAR 09 - Explosives
- CAR 10 - Working with electricity
- CAR 11 - Molten metal

The requirements in this document must be included in the control measures established within the area's risk management. Therefore, the prevention of incidents related to critical activities is not limited to complying with this document.

All requirements described in this document are mandatory, must be implemented by leadership in their respective areas and are auditable.

It is essential to comply with the elements of Vale Production System (VPS), with attention to: Perception and Risk Management (4); Change Management (9); Health, Safety, Environmental and Community; (5) and Emergency planning (12).

Questions and questions related to this document should be forwarded to the Health, Safety and Operational Risk department by email saude.seguranca.corporativa@vale.com.

Compliance with legislation

Complying with the requirements in this document does not cover all requirements in local health and safety legislations. Therefore, full compliance with local health and safety legislation must be adopted as a basic premise.

In case of conflict between a requirement in this document and that of the local legislation, the one that is most stringent in health and safety must be applied.

Exception criteria

In the event of the absolute impossibility to comply with any requirement in this document or the need to replace this requirement with another practice, equipment or facility that is equivalent in risk reduction, the following must be adopted, under the sole responsibility of the requesting department:

- a) Preparation of technical study including, as a minimum, the description of the activity, justifications for non-compliance or replacement, proposed control measures and documented risk analysis;

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- b) Formal approval from the business unit Executive Manager;
- c) Communication and submission of the study to Vale's Health, Safety and Operational Risks Department.

The HSOR Department must review the Technical Study and approve or decline the exception for non-compliance or requirement substitution. Any cancellation of the non-compliance or replacement request must also be formally reported to the Health, Safety and Operational Risks Department.

Criteria for short-term occasional access

Short-term Occasional access where employees are expected to perform critical activities may be permitted without the need for applicable RAC training as per the procedure below:

- a) Orientation with the site's general safety rules, including emergency procedures.
- b) Preparation of a documented risk analysis, with the participation of those involved to discuss risk situations and control measures.

Where applicable, employees must have training records that demonstrate compliance with local legislation. This permission is not applicable for Vale employees.

General requirements

- a) This document must be referenced and incorporated into procedures regarding local practices and safety equipment and devices must be designed, installed, manufactured and/or purchased as prescribed by legislation, technical standards and/or manufacturers specifications;
- b) Modifications to equipment must be made upon approval by the manufacturer. When the manufacturer is not commercially or technically available, modifications must be made according to a formal project by a qualified professional. Modifications must follow the local management of change process;
- c) The training required in the RACs must follow the Vale/HR Training Guidelines for the country concerned.
- d) Training conducted in one site must be accepted in other sites;
- e) It must be implemented a health assessment program in accordance with local legislation, for employees mapped to perform critical activities. The program must comply with local legislation and follow the standards of the "PGS-003523 Corporate Guideline for Occupational Health Management".

Roles and Responsibilities

- a) Business units must:
 - I. Keep a list of requirements that the unit failed to comply with or replaced out of necessity, as per item "Exception criteria" of this document;
 - II. Keep a list and quantity of employees who perform critical activities under this document;
 - III. Maintain an action plan for the implementation of new requirements under this document, considering the implementation deadline of these new requirements.
- b) Local Health and Safety areas must:
 - I. Plan, coordinate and monitor the implementation, maintenance and compliance with Critical Activities Requirements;
 - II. Support contract managers and leaders in the procurement and contracting processes of goods and services related to the Critical Activities Requirements;

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III. Unfold the requirements of this Instruction to management and supervisory level employees.

c) Management and Supervisory Level Employees:

- I. Ensure implementation and compliance with Critical Activities Requirements;
- II. Ensure that all employees involved in performing critical activities are competent professionals;
- III. Ensure the training of employees to perform critical activities.

d) Health, Safety and Operational Risks Department:

- I. Provide technical assistance to Business Units in the implementation, compliance and monitoring of Critical Activities Requirements;
- II. Review the document and establish maximum deadlines for complying with the new critical activities requirements.

Notes about the revision

This document is valid from the date of its publication. The deadline for implementing new requirements (identified in bold) is:

a) CARs 01 to 05:

- Equipment and installations: 12/20/2020
- Procedures: 06/20/2020
- Requirements of section 1.7.7 of CAR 01 and requirement 5.7.q of CAR 05: 12/15/2021.

b) CARs 06 to 11: the requirements of CARs 06 to 11 are valid, but deadlines for implementation will be defined from the GAP analysis to be carried out in 2022.

Note: Annexes III and IV of this document (Deadlines specified by requirement and treatment for non-compliance with CAR requirements) are valid only for CARs from 01 to 05.

CAR adherence

Data on compliance to CARs come from adherence protocols available in SAP – IM. Through these protocols, the areas must respond if the requirements are complied.

The Executive Management or Area Management protocol must be updated once a year to compose the official adherence result.

It is strongly recommended, however, that the protocols are updated at least twice a year, once before the budget cycle and the other before the end of the year.

Only data registered through these protocols will be considered official and will appear in the global dashboard for adherence to CARs.

1. RAC 1 – WORKING AT HEIGHT

1.1 Foreword

A significant portion of fatalities and high-potential incidents at Vale had occurred during work at height. The main contributing factors associated with these incidents were:

- a) Failure to perceive the risk situation;
- b) Work space for inadequate or congested work;
- c) Defective / inadequate guards or barriers;
- d) Undertaking the activity in an unsafe manner;
- e) Defective / inappropriate tool or equipment;
- f) Absence of barrier that prevents falling of person or object.

1.2 Purpose

Establish Health and Safety requirements to eliminate, control and minimize the risk of fatalities, injuries or incidents involving work at heights.

1.3 Application

Work activity where there is a risk of falling people and objects due to a level difference equal to or greater than 1.80 meters.

1.4 Exceptions

Work activity where there is no risk of falling people and objects due to a level difference equal to or greater than 1.80 meters.

1.5 Important definitions

- **Anchorage Point:** Certified point for installing an anchoring system such as pre-engineering devices and connection elements for working at height.
- **Body harness:** A device worn on the body (from the hip area to the upper torso) that can prevent a worker from falling vertically or nearly vertically.
- **Connector:** Device that opens and closes, developed to unite different components of a fall protection system. Has versions with automatic closing, with manual lock and automatic lock.
- **Collective fall protection elements:** sections or parts of handrails (upper beam, intermediate beam and foot wheel), including trapdoor, floor plate or railing guardrails and their structural support elements that typically comprise the elements of walkways, platforms, safety net for working at heights and elevated areas.
- **Coupled man basket:** Bucket or platform attached to a vehicle crane for lifting people and performing work at height, with or without electrical isolation, and it can also lift support material indispensable for the performance of the service.
- **Elevated work area and walkways:** Access and work areas composed by floor and railing (toe board, intermediate and upper handrail) and that follow engineering standards.
- **Fall arrest protection:** An assembly of components that when the assembly is connected to an anchor point, it is capable of arresting a worker's fall.
- **Fall arrest system:** System used to arrest a person in a fall from an elevation. It consists of an anchorage, connectors and full-body harness, and may include a lanyard, deceleration device and/or lifeline.

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- **Travel restraint:** A type of fall displacement system that is designed to limit a worker's movement and the potential for a finite distance fall.
- **Fall Protection System - FPS:** System designed to eliminate the risk of falling workers or to minimize the consequences of falls in activities performed above 1.80 m.
- **Fall protection:** A method of minimizing the possibility of falling.
- **Lanyard:** A certified line / strap having a connector at each end for connecting the body belt or body harness to an anchorage point.
- **Man Basket:** Vehicle equipment intended for lifting people to perform work at height, with movable, articulated, telescopic or mixed arm, with bucket or platform, with or without electrical isolation, and it also can, as long as it is designed for this purpose, lift material by winch and complementary boom (JIB), complying with the manufacturer's specifications.
- **Self-retracting lifeline:** A certified line that automatically adjusts its length under mild tension and, under high tension, locks to arrest further movement or a fall.
- **Suspended man basket:** Set formed by the suspension system and the bucket or platform suspended by crane equipment.
- **Travel restraint system:** A system capable of restricting a person's movement on a work surface and preventing the person from reaching a location from which he or she could fall.
- **Work positioning systems:** Aerial or elevating work platforms, ladders, boatswain's chairs, suspended baskets and scaffolding.

1.6 Requirements for installations and equipment

1.6.1 General requirements to prevent fall of objects, materials and tools:

- a) Area isolation and warning: Isolation and warning must be done **with physical barriers, such as barrier mesh and pedestal**. For short-term activities, after risk analysis performed by the area, other types of isolation and signaling such as nylon tape, ropes or chains may be used. **The use of plain plastic zebra tape is prohibited;**
- b) Tool securing system;
- c) Toe board with minimum height according to local regulations¹, at the bottom of lifting equipment, scaffolding, platform ladders and places where there is a risk of falling objects;
- d) **Safety nets, where, due to the nature of the activity, isolation of the area is impossible, and the presence of persons involved in the work at a lower level is required.**

1.6.2 General requirements to prevent fall of people:

- a) Handrail, in lifting equipment, scaffolding, platform ladders, excavations and places where there is a risk of falling people, designed in accordance with local regulations², containing:
 - I. Upper railing;
 - II. Mid section railing.
- b) Full Body Safety Harness including double safety strap with double lock rigging gear;
- c) Life line must be affixed to independent structure at:
 - I. Activities using ropes;
 - II. Using suspended scaffolds;
 - III. Using Suspended chairs;

¹ In the absence of local standards that establish a minimum height for toe boards, another rule must be adopted with the consent of Vale's Health, Safety and Operational Risks Board.

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- IV. Exposed to the risk of falling due to a structural collapse;
- V. Truss-out scaffold.

1.6.3 General requirements for the scaffold:

- a) Be metallic ²and designed under the responsibility of the qualified professional (or equivalent, according to local legislation).
- b) Be of the tubular, platform, wedge, or clamp type, with protection in the clamps in accesses and work areas.
- c) Be dimensioned by a qualified professional.
- d) Have the trapdoor equipped with physical barriers around it, to prevent people from falling.
- e) Be assembled from projects that contemplate, among others, the necessary accesses for evasion of users during emergency scenarios.

1.6.4 Variable requirements according to scaffold:

Specific Requirements	Fixed supported scaffold	Mobile supported scaffold	Suspended scaffold
(a) Access ladder incorporated to the structure.	X	X	
(b) Shoes in solid / resistant bases.	X		
(c) Locking of casters.		X	
(d) Automatic mechanical locking device, meeting the maximum cargo capacity of the equipment.			X
(e) Independent life line.			X
(f) Visible plate with maximum allowable workload.	X	X	X

1.6.5 General requirements for the ladders:

- a) Any type of ladders must contain dimensions, including intermediate levels, according to local regulations.
- b) **For access on fixed vertical stairs above 1.80 meters, it is mandatory to use at least one of the requirements below:**
 - I. **Fixed life line;**
 - II. **Retractable fall arrester;**
 - III. **Full body safety harness with double layard;**
 - IV. **Safety cages, properly installed, in locations where local legislation accepts that safety cages act as protection against falls on fixed vertical ladders**

1.6.6 Variable requirements according to ladder³ type (mobile):

Specific Requirements	Simple ladder	Double dadder (Opened)	Extendable ladder	Fixed ladder cage
(a) Steps and platforms whit material non-slip surface.	X	X	X	X
(b) Non-slips shoes.	X	X	X	X
(c) Specific maximum length	X	X	X	
(d) Stabilization devices / Locking of casters				X

² Check the requirement of RAC 10, 10.7.1 (u) for assembling and disassembling scaffolds made of conductive material in electrical work where they may meet energized surfaces.

³ Check and follow the requirement of RAC 10, 10.7.1 (t) for the use of metallic ladders in electrical work.

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1.6.7 General requirements for people hoisting equipment:

- a) Anchoring point for safety harness;
- b) Movement control of the platform or basket on the lower control panel;
- c) Emergency stop device on the lower control panel.

1.6.8 Variable requirements according to equipment:

Specific Requirements	Aerial Work Platform	Lifting Equipment to hoist people			
		Man Basket	Coupled Basket	Man	Suspended Man Basket
(a) Stabilizer system with inclination indicator.	X	X	X		X
(b) Wheel lock / braking system	X	X ⁴			
(c) Emergency system allowing arm movement and tower rotation in case of failure.	X	X	X		
(d) System that allows basket leveling and prevents inclination.	X	X	X		
(e) Visual sound signaling during the vertical movement of the equipment.	X				
(f) System that prevents stabilizer shoes from operating without the previous retraction of the mobile arm		X	X		
(g) Anemometer ⁵ with visual and audible alarm.	X				X
(h) Boom radius and angle indicators with visual and audible alert					X
(i) Block lift height indicator that stops lifting when reaching set height.					X
(j) Physical or electronic device or proximity sensor that prevents the impact of the upper part of the equipment against another structure.	X				

1.7 Procedural requirements**1.7.1 General requirements for procedures:**

- a) Before any activity that involves working at heights, in the planning stage, one must analyze and define which protection system against individual and/or collective falls will be adopted;
- b) Equipment at work at height must undergo initial, pre-use and periodic inspection;
- c) Full body safety harnesses must be secured during any activity involving a structure that offers a risk of falling as per a JSA or JHA;
- d) The use of an abdominal body harness (miners belt) is prohibited. The abdominal component of the harness should be used only for work positioning and travel restraint;

1.7.2 Requirements for scaffolds:

- a) Be supported by a resistant structure; when equipment and/or installations used to support scaffolds must be resistant enough to avoid any collapse;
- b) Be constructed on a flat surface free of damage or deformation;

⁴ When not using outriggers⁵ Manual anemometer can be adopted. Must be installed on the equipment.

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- c) The trapdoor and the barrier around it must always be closed;
- d) Be formally released for use by:
 - I. The verification of compliance with the project;
 - II. Completing the inspection checklist;
 - III. The signature of the person responsible for the release;
 - IV. Indication of approval to be used/not approved to be used through plate or tag.
- e) The movement of mobile scaffold with equipment, tools or objects on or supported is prohibited;
- f) Units must designate representatives - called scaffolding inspectors - duly empowered to verify and ensure the execution of scaffolding in accordance with the assumptions of their designs, including verification of assembly modifications, duly documented by assembly service providers based on technical criteria established by the specialized assembly company;
- g) Units, through their engineering departments, must provide information so that scaffolding structure designs that may be mounted on (supported) process equipment meet the mechanical strength limits of such equipment in order to avoid collapses thereof, their structures and devices.

1.7.3 Equipments for hoisting people:

- a) Suspended man basket activities may only be performed in rescue and emergency situations;
- b) Stabilization of hoisting equipment on level ground must be achievable with maximum extension of stabilizer arms;
- c) To exit or enter the basket of the aerial work platform when it is raised, the worker must maintain 100% tie-off to an approved anchor designed for fall arrest. The activity must be supported by a task specific risk analysis or Job Hazard Analysis, which must include controls to prevent inadvertent movement of the basket.

1.7.4 Requirements for anchor point:

- a) The anchor point must be resistant to the stresses imposed;
- b) The anchor system must be designed by a certified professional;
- c) The integral structure of an anchorage system must withstand the maximum applicable force;
- d) The anchoring point system must be selected such that the impact force transmitted to the worker is not more than 6kN upon any fall;
- e) The anchor system must follow the applicable technical standards;
- f) The anchor system must be installed by a qualified professional (under the responsibility of a qualified professional);
- g) Periodic inspection of the anchor system must occur with a frequency no longer than annual;
- h) Vale's fixed anchor system inspections and service providers must be recorded in a central system (preferably computer based) where such this information may be tracked.

1.7.5 Requirements for rescue at height:

- a) The Emergency Response Plan must contain existing work at heights scenarios and staff must be qualified and prepared, and appropriate equipment for rescuing at heights;
- b) Rescue conditions involving inert suspension must be simulated and actions taken to reduce the suspension trauma scenario.

1.7.6 Requirements for rope access:

- a) Rope access must be performed if the following conditions are verified:

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- I. The slope of the ground surface in the workplace does not enable the worker to perform his activities without risk of falling and without rope support;
- II. The worker needs rope during the activity in order to keep himself standing on the work structure/surface;
- III. It is necessary to use 2 ropes to perform the activity, one for task and one for rescue;
- IV. Rope is needed for the worker to reach a certain point of the structure without risk of falling;
- V. Rope is needed for the worker to move vertically and horizontally over the work structure;
- VI. The height to the next lower plane is greater than 1.8 meters.

1.7.7 Requirement for removing floors, railings, guard rails, trap doors and other elements of collective fall protection:

- a) During the planning stage, before carrying out a removal of these elements in order to offer exposure to the risk of falling from height, one must analyze other safer ways of carrying out the activity without carrying out such removal. If the need for the opening is confirmed, the requirements below must be followed
- b) Openings with the risk of falling must be previously planned and approved by the area owner by issuing a Safe Work Permit (SWP) and containing a Risk Analysis for the activity
- c) Before the start of the activity, the opening location must be adequately isolated with a physical, rigid and fixed barrier to prevent unauthorized access and be clearly signaled informing the risks of the location.
- d) Every worker exposed to the risk of falling from the opening must be anchored in a fall protection system, according to item 1.7.4.
- e) The opening must be carried out by persons trained and authorized to work at heights (CAR01 and local standards) and applicable procedures.
- f) The opening caused by the removal of a floor, guardrail or hatch cover must be completely isolated with a physical, rigid and fixed barrier to prevent unauthorized access and be clearly signaled informing the risks of the place.
- g) At the end of the activity, the opening must be closed immediately and the place must be regularized with the assurance that the installation is in safe conditions for use.
- h) Hatches must be inventoried and their use controlled by padlocks.
- i) Collective fall protection elements should be periodically inspected taking into account, as a minimum, the requirements of PGS – 004728 – Floor Gratings, Openings and Trap Doors.

1.8 Training requirements

- a) Employees who perform activities at height, considering the applicability criteria of this RAC, should be trained in:
 - I. RAC 01, including retraining, according to Valer guideline;
 - II. Training (s) for working at height required by local law.
- b) **The legally qualified professional responsible for the elaboration of a fall protection system should be specifically trained in this subject, following the premises of the local legislation;**
- c) Employees operating aerial work platforms and personnel lifting equipment must be certified in the safe operation of such equipment.

1.9 Roles and responsibilities

1.9.1 Contract Manager:

- a) Ensure all CAR requirements are implemented in his/her areas;
- b) Follows the services suppliers safety performance and requirements accomplishment;
- c) Participate on any incident related event investigation involving work at height activities performed by contractors.

1.9.2 Maintenance Planning and Scheduling:

- a) Need to know the CAR requirements applicable to his/her areas and ensure that risk analysis for work at height are initiated on his/her work process steps.

1.9.3 Tool Shop Supervisor and/or Resources (Materials) Responsible (professionals in charge to manage the work at height equipment and devices):

- a) Ensure that all devices for work at height are inspected on receiving step, as well as, periodically;
- b) Set the inspection plan including frequency according to related regulatory requirements. Segregate and send for disposal all equipment and device in nonconformance condition.

1.9.4 Supervisor:

- a) Provide support for risk analysis of activities involving work at height;
- b) Support the engineering area to identify and define points to apply fixed or mobile anchorage systems (pre-engineered devices);
- c) Support the Vale scaffolding inspector;
- d) Set all working at height scenarios and activities mapped and update;
- e) Provide performance feedback of service for supply;
- f) Perform risk analysis to define (if applicable) the rope access;
- g) Keep all risk scenarios identified at working at height.

1.9.5 Scaffolding Inspector:

- a) Verify and ensure that scaffolding assembling according to the related Project assumptions, including the changes on scaffolding, and following the service providers documents, based on technical criteria set by specialized scaffolding assembling.

1.9.6 Anchorage and Fall Protection System Specialist:

- a) Assigned, skilled and legally authorized to elaborate anchorage systems and its fixing elements projects.

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2. RAC 02 – LIGHT MOTOR VEHICLES

2.1 Foreword

Several incidents with critical or catastrophic potential have occurred with the involvement of light motor vehicles. The main causes of these events are:

- a) Speed incompatible with the road conditions;
- b) Vehicle instability;
- c) Poor conditions of the vehicle;
- d) Lack of visibility;
- e) Driver fatigue;
- f) Driver distraction;
- g) Other risky driver behaviors.

2.2 Purpose

Establish requirements for the safe operation of motor vehicles at service of Vale.

2.3 Application

This RAC applies to the operation of Vale owned, leased and rental light motor vehicles, while at service of Vale. The RAC also applies to service provider vehicles operated as part of a Vale contract in public or Vale roads (including underground and surface mining areas).

Types of light motor vehicles covered in this document include: automobiles, sport utility vehicles, pick-up trucks, minivans, full size vans, and buses (both compact and full size).

2.4 Exceptions

This document does not apply to:

- a) Vehicles which are not at service of Vale, driven by people who have permission to access the Sites of Vale⁶;
- b) Vehicles for emergency response.

2.5 Important definitions

- **Mine Area:** areas used for mining activity, such as open pits, underground mines, permanent travel routes, shift change areas, lookouts, maintenance workshop, where the access of vehicles, equipment and people is controlled.
- **Dedicated Vehicles:** vehicles of permanent use or rented for more than three months.
- **Mining Operations:** areas where the following activities occur including drilling and blasting, mining, material loading and unloading and dumping of waste rock.
- **Operational Area:** all internal areas of Vale's Sites (terminals, power plants, railways, mining areas, internal parking areas, among others), where the access of motor vehicles, mobile equipment and people is controlled.
- **Operational road:** the roads, access roads and traffic routes in the operational area.

⁶ However, the specifications of these vehicles must comply with local legislation and drivers must obey the Site Traffic Plan.

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- **Primary Auxiliary Braking System Speed Retarding (engine brake):** mechanical braking which reduces or keeps the speed of the vehicle, when the driver takes the foot off the accelerator pedal while the vehicle's engine is in low gear on a descent
- **Rental vehicle:** vehicles that are rented directly from approved car rental companies, at airports or agencies. These contracts must not extend over 3 consecutive months, regardless of whether it is a single contract or different contracts.
- **Secondary auxiliary braking system (hydraulic retarder + electromagnetic):** an auxiliary braking system that works independently of, and in conjunction with, the service brakes and engine braking.
- **Speed monitoring system (telemetry):** wireless data transmission and reception technology designed to remotely monitor vehicles.

2.6 Requirements for installations and equipment

2.6.1 Requirements for the operating roads and circulation of light motor vehicles:

- All the operating roads must be identified in the Traffic Plan;
- Physical barriers or protective devices (such as walkways, bumps or lights activated by pedestrians on safe walking paths, among others). Must be installed, to segregate the interfaces between people and motor vehicles as much as possible, where there is a significant risk of contact between vehicles and people;**
- Speed road signs must be installed at regular intervals indicating maximum allowable speed on the internal roads;**
- Parking areas must be designated for parking light motor vehicles the areas must allow a safe separation from mobile equipment);**
- Traffic routes for the circulation of mobile equipment, vehicles and pedestrians must be clearly identified;**
- The internal roads of permanent facilities must be preferentially paved. The mining areas must be leveled;**
- In underground mining, cutouts must be designed for the parking of motor vehicles in a way that does not interfere with the traffic in the main roads.**

2.6.2 Requirements for all light motor vehicles:

- The use of motorcycles, bicycles, tricycles, quadricycles and other vehicles not mentioned in this document, at service of Vale and/or inside Vale property, is prohibited;**
- All vehicles must receive the required preventive maintenance as recommended by the manufacturer;
- Modifications in motor vehicles must only be done with the formal approval of the manufacturer.

2.6.3 Specific Requirements for light motor vehicle on public roads:

Specific Requirements ⁷	Dedicated Vehicles	Rental Vehicles	Vans	Micro buses	Buses
a) Three-point seat belts for all passengers	X	X			
b) Three-point seat belts for first row of seats and two point for other seats			X	X	X
c) Headrest or high backed (bucket) seat with fixed head restraint for all passengers	X	X	X	X	X

⁷ Where vehicles are manufactured with Anti-Rollover Devices (ROPs), it is recommended that this option be adopted as a further protective barrier for the vehicle occupants.

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d) Front airbag for the driver and the front seat passenger	X	X	X		
e) Anti-lock braking system (ABS)	X	X	X		
f) Vehicle warning signaling devices such as reflective triangles and / or cones	X	X	X	X	X
g) Audible Reverse Alarm ⁸	X		X	X	X
h) Reverse Sensor or vehicle backup camera	X		X	X	X
i) Location and speed monitoring system (telemetry)	X		X	X	X
j) Driver drowsiness detection system	X ⁹		X	X	X
k) Electronic Braking Control (EBD)					
l) Stability control					
m) Four wheel or permanently engaged all-wheel drive systems					
n) Traction control system					
o) Reflective striping					
p) communication system between vehicles and mobile equipment					
q) Visible pennant with LED light at the tip, installed according to the height of the highest equipment circulating in the mine					
r) Roof Mounted flashing, rotating or strobe light					
s) Proximity Alert Sensor for Heavy Equipment, with audible alert sound					
t) Primary Auxiliary Braking System Speed Retarding (engine brake)				X	X
u) Secondary auxiliary braking system (hydraulic retarder + electromagnetic)					X ¹⁰
v) Emergency exits with single handle opening mechanism				X	X

2.6.4 Specific Requirements for light motor vehicles travelling in internal areas (operational or administrative):

Specific Requirements ¹¹	Dedicated Vehicles	Vans	Micro buses	Buses
a) Three-point seat belts for all passengers	X			
b) Three-point seat belts for first row of seats and two point for other seats		X	X	X

⁸ Light motor vehicles owned by Vale or at Vale's service do not need to use the reversing audible alarm on public roads, administrative areas or close to Vale's neighboring communities

⁹ Consult requirement 2.7.c.v below

¹⁰ Buses with a Total Gross Weight greater than or equal to 17 tons must have Auxiliary System II (Hydraulic or Electromagnetic Retarder). The non-applicability of this device on some buses with a Total Gross Weight greater than or equal to 17 tons must be justified based on a risk analysis.

¹¹ Where vehicles are manufactured with Anti-Rollover Devices (ROPs), it is recommended that this option be adopted as a further protective barrier for the vehicle occupants.

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c) Headrest or high backed (bucket) seat with fixed head restraint for all passengers	X	X	X	X
d) Front airbag for the driver and the front seat passenger	X	X		
e) Anti-lock braking system (ABS)	X	X		
f) Vehicle warning signaling devices such as reflective triangles and / or cones	X	X	X	X
g) Audible Reverse Alarm	X	X	X	X
h) Reverse Sensor or vehicle backup camera	X	X	X	X
i) Location and speed monitoring system (telemetry)	X	X	X	X
j) Driver drowsiness detection system	X ¹²	X	X	X
k) Electronic Braking Control (EBD)				
l) Stability control				
m) Four wheel or permanently engaged all-wheel drive systems				
n) Traction control system				
o) Reflective striping				
p) communication system between vehicles and mobile equipment				
q) Visible pennant with LED light at the tip, installed according to the height of the highest equipment circulating in the mine				
r) Roof Mounted flashing, rotating or strobe light				
s) Proximity Alert Sensor for Heavy Equipment, with audible alert sound				
t) Primary Auxiliary Braking System Speed Retarding (engine brake)			X	X
u) Secondary auxiliary braking system (hydraulic retarder + electromagnetic)				X ¹³
v) Emergency exits with single handle opening mechanism			X	X

2.6.5 Specific Requirements according to light motor vehicle that access mining operation:

Specific Requirements ¹⁴	Dedicated Vehicles	Micro buses
a) Three-point seat belts for all passengers	X	
b) Three-point seat belts for first row of seats and two point for other seats		X
c) Headrest or high backed (bucket) seat with fixed head restraint for all passengers	X	X

¹² Consult requirement 2.7.c.v below

¹³ Buses with a Total Gross Weight greater than or equal to 17 tons must have Auxiliary System II (Hydraulic or Electromagnetic Retarder). The non-applicability of this device on some buses with a Total Gross Weight greater than or equal to 17 tons must be justified based on a risk analysis.

¹⁴ Where vehicles are manufactured with Anti-Rollover Devices (ROPs), it is recommended that this option be adopted as a further protective barrier for the vehicle occupants.

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d) Front airbag for the driver and the front seat passenger	X	
e) Anti-lock braking system (ABS)	X	
f) Vehicle warning signaling devices such as reflective triangles and / or cones	X	X
g) Audible Reverse Alarm	X	X
h) Reverse Sensor or vehicle backup camera	X	X
i) Location and speed monitoring system (telemetry)	X	X
j) Driver drowsiness detection system	X ¹⁵	X
k) Electronic Braking Control (EBD)	X	
l) Stability control	X	
m) Four wheel or permanently engaged all-wheel drive systems	X	X
n) Traction control system	X	
o) Reflective striping	X	X
p) Communication system between vehicles and mobile equipment	X	X
q) Visible pennant with LED light at the tip, installed according to the height of the highest equipment circulating in the mine	X	X
r) Roof Mounted flashing, rotating or strobe light	X	X
s) Proximity Alert Sensor for Heavy Equipment, with audible alert sound	X	X
t) Primary Auxiliary Braking System Speed Retarding (engine brake)		X
u) Secondary auxiliary braking system (hydraulic retarder + electromagnetic)		
v) Emergency exits with single handle opening mechanism		X

2.6.6 Specific Requirements for Utility Terrain Vehicles¹⁶ (UTV) and Snowmobiles:

Specific Requirements	Utility Vehicles (UTV)	Snowmobiles
a) Rollover Protection Structures (ROPs)	X	
b) Three-point seat belts	X	
c) Reflective striping	X	X
d) Roof Mounted flashing, rotating or strobe light	X	
e) Fire extinguishers	X	X
f) Laminated windshields with wipers	X	
g) Helmets	X	X

¹⁵ Consult requirement 2.7.c.v below

¹⁶ The use of Utility Terrain Vehicle (UTV) and snowmobiles should only be used where light vehicles are unable to access due to terrain and legal environmental restrictions for opening access roads.

2.7 Procedural requirements

- a) All persons who drive vehicles at the service of Vale, inside or outside Vale property, must comply with the following rules:
- I. Comply with the Site traffic plan;
 - II. **Do not drive under the influence of alcohol and drugs;**
 - III. Ensure that the number of passengers fits with the number of 3-point seat belts and head restraints available in the vehicle;
 - IV. The driver of buses, micro-buses, vans and minivans must obey the maximum capacity of the vehicle;
 - V. Ensure that all vehicle occupants use the seat belt at all the time while the vehicle is in movement;
 - VI. Respect the speed limits established by the road signs or the legislation;
 - VII. Always have the headlights turned on while the vehicle is in movement;
 - VIII. Do not use the following devices, except when the vehicle is parked in a safe place: TV / DVD, headset sound and mobile phone (including headphones and handsfree features);
 - IX. Have the vehicle parking brake applied and the vehicle engine turned off before leaving the vehicle's direction, except when a different practice is documented in a safety operating procedure approved by the manager;
 - X. Chock the wheels of vans, minibuses or buses after parking the vehicles;
 - XI. Always keep the two-way communication radio turned on for interaction with other vehicles and equipment, as well as the gyroscopic light always on, in the vehicles which transport personnel in underground mining areas;
 - XII. Have a high visibility flag installed on top of the vehicle antenna, always keep bidirectional communication radio turned on for interaction with other vehicles and equipment, and gyro light always on, in the vehicles which transport personnel carriers in surface mining areas;
 - XIII. Only transport cargo in vehicles suitable for this, considering the type and size of cargo to be transported, in compliance with local legislation. Always use a mooring system compatible with local legislation to carry loads;
 - XIV. In vehicles, baggage must be packed or affixed to ensure the safety of occupants;
 - XV. Communicate any damages, breakdowns, collisions and accidents to Vale's leadership and report them in the official system.
- b) All Vale Sites must have a Traffic Plan that includes the basic elements described in Annex;
- c) Local procedures must be implemented in all operational areas that have mobile equipment circulation and these must include, in synergy with the operational area Traffic Plan:
- I. Formal initial mobilization inspection of the vehicle;
 - II. **Formal inspection of lights, tires and general conditions for each change of the vehicle driver;**
 - III. Fatigue Plan, as per PGS-004099 – Guidelines for Fatigue Prevention Programs;
 - IV. **Telemetry management system, including:**
 - **System for periodic and routine verification of the information available;**
 - **Consequence Policy in case of violations.**
 - V. **Management of drowsiness detection systems, including:**
 - **The definition of the implementation of the drowsiness detection system in dedicated vehicles according to Guidelines of the Fatigue Prevention Programs (PGS-004099);**

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- System for periodic and routine verification of the information available;
- Reporting of anomalies;
- Actions to be taken in case of deviation.

2.8 Training requirement

All persons who drive vehicles at the service of Vale must:

- a) Be trained in RAC 02 according to the Valer guidelines;
- b) Have a valid driving license specific for the type of motor vehicle, according to local legislation;
- c) Have all the required training within the expiration date.

2.9 Roles and responsibilities

2.9.1 Leader of each location / site (supervisor, manager or director):

- a) Implement the Traffic plan;
- b) Implement the requirements for light motor vehicles;
- c) Implement the specific procedures previewed in this RAC;
- d) Approve modifications or inclusion of safety accessories in the light motor vehicles.

2.9.2 Leader of each operation / project (supervisor, manager or director):

- a) Document the inventory of light motor vehicles at service of Vale in the location, for Vale and contractor companies' vehicles;
- b) Document the list of people authorized to drive the vehicles validated by their immediate superiors and trained in Preventive Driving, containing the following information:
 - I. Training dates;
 - II. Date of next refresher training;
 - III. Number and date of expiration of driving licenses, including people who drive rental cars.

3. RAC 03 – MOBILE EQUIPMENT OPERATION

3.1 Foreword

Over the past 10 years, a number of potentially critical and catastrophic incidents involving mobile equipment have occurred in Vale's operating areas. The main contributing factors of these events were:

- a) Equipment operating conditions;
- b) Equipment instability;
- c) Equipment fires;
- d) Speed incompatible with road conditions;
- e) Lack of visibility;
- f) Defective or inadequate protection barriers;
- g) Operator fatigue;
- h) Other risky operator behaviors.

The requirements contained in this document were consolidated and defined from the analysis of the contributing factors of these events and constitute the main barriers and mitigation elements that must be implemented in Vale's operating areas that have mobile equipment in order to prevent high potential incidents from occurring.

3.2 Purpose

Establish requirements for the safe operation of mobile equipment at Vale.

3.3 Application

Operation of Vale's own, leased or rented surface and underground mining mobile equipment, as well as equipment of service providers that are subject to the scope of Vale's contract and that circulate on public roads, operating areas, mining areas and operational routes.

3.4 Exceptions

The requirements of this RAC do not apply to:

- a) Motor vehicles covered by RAC 02;
- b) Equipment moving exclusively on railway tracks;
- c) Ship loaders;
- d) Overhead cranes;
- e) Monorails;
- f) Aerial work platforms;
- g) Stacker reclaimers and mobile stacker;
- h) Prerequisites for the transport of dangerous goods;
- i) Emergency response equipment.
- j) Equipment used for groundskeeping (mini lawn mowers & mini sweepers)

Mobile equipment for lifting personnel and/or load must also comply with the requirements of RACs 01 and 05, respectively.

3.5 Important definitions

- **Anti-collision system with automatic braking of equipment:** system installed on mobile equipment, motor vehicles and/or people, for their georeferencing, and that acts automatically on the braking system of equipment and vehicles when there is the risk of an imminent collision.
- **Large mobile equipment:** equipment with a tare of 45 tons or more.
- **Mine Area:** areas used for mining activity, such as open pits, underground mines, permanent travel routes, shift change areas, lookouts, maintenance workshop, where the access of vehicles, equipment and people is controlled.
- **Mobile equipment without cabin:** equipment without any type of protective structure for the physical integrity of the operator.
- **Mining Operations:** areas where the following activities occur including drilling and blasting, mining, material loading and unloading and dumping of waste rock.
- **Mobile Equipment:** motor-driven equipment used to move, transport, excavate, displace or push materials.
- **Mobile underground mining equipment:** loader, lorry, transporter, roof hoisting and throwing equipment, motor grader, backhoe, drilling rig, scalers, rig - non exhaustive list.
- **Operating routes:** roads, accesses and traffic roads within the mining areas. It's also considered operating routes piers and its access.
- **Operational Area:** all internal areas of Vale's Sites (Terminals, Power Plants, Railways, Mining Areas, internal parking Areas, among others), where the access of motor vehicles, mobile equipment and people is controlled.
- **Other trucks:** road truck, tipper truck, track truck, articulated truck, bucket truck, tank truck, road train truck, stump truck, flatbed trailer truck and articulated truck mounted crane. The latter must also meet the requirements of RAC-05 - Load Lifting.
- **Proximity alert system between equipment:** system installed on mobile equipment, motor vehicles and/or people that allows georeferencing and triggers an alert if they are within a defined proximity limit.
- **Restricted Areas (Exclusion Zones):** operational areas where the access of people, vehicles and equipment must be restricted and controlled, primarily to reduce the number of people exposed and the potential of accidents.
- **Safety distance:** minimum distance from the equipment or vehicle in front, which allows the driver or operator to stop the vehicle or equipment without causing a collision in the event of braking or sudden stopping of the vehicle in front.
- **Surface mobile equipment:** motor grader, scraper, backhoe, excavator, tractor, forklift, tire handler, dump trucks, other trucks, drilling rig, skid steer loader - non exhaustive list.
- **Synchronized gearbox:** mechanical device installed in the gearbox, which allows matching of the toothed element speeds before gear engagement, allowing smooth shifts without jumps and without the need to stop equipment.
- **Telemetry:** wireless data transmission and reception technology designed to remotely monitor mobile equipment and motor vehicles.

3.6 Requirements for installations and equipment

3.6.1 Requirements for mobile equipment operating routes:

- a) Protective berms must be constructed with a minimum height equal to half the diameter of the largest tire among equipment that travel on the surface mining areas:
 - I. On all operating routes;

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- II. Along excavations;
- III. In areas where there is a risk of equipment falling or rollover;
- IV. **Around the equipment, during parking in mining areas (except workshops) for maintenance or interference;**
- V. **Around electrical equipment such as panels, transformers and electric poles;**
- VI. **On the exposed sides of pipelines located at ground level or suspended (pipe racks), near the operating routes;**
- VII. **In the vicinity of the explosive storehouses.**
- b) **In underground mining areas, where it is not possible to construct berms, other types of physical barriers must be adopted to isolate the area;**
- c) **All electrical lines, pipelines and structures in mining areas must be properly signaled;**
- d) Safety barriers (such as beams, limiters, height sensors) must be installed for the operation of mobile equipment in the vicinity of air and underground obstacles;
- e) In operational areas and mining areas, where there is a significant risk of contact among equipment and people, the following must be done:
 - I. Install physical barriers or protective devices (such as air walkways, bumps, gates or lights activated by pedestrians on safe paths, roads, accesses, etc.) that separate as much as possible the interfaces among people and mobile equipment;
 - II. **Provide two-way communication radios, if there are road observers or spotters, so that they can communicate with the operators of the mobile equipment.**
 - III. **Post signs and barricade the area during the material handling, taking into account the operating range of the equipment and their implements.**

3.6.2 Requirements for all mobile equipment:

- a) Trucks must have synchronized gearboxes;
- b) Mobile equipment with pivot points where there is a risk of crushing or pinching must have that hazard clearly and visibly signaled;
- c) Mobile equipment with outrigger floats (stabilizer systems) must be hydraulically actuated;
- d) **The access ramps of the board trailers must have an electro-hydraulic system to move the access ramps;**
- e) **Mobile equipment must have maximum load and tare signaling;**
- f) **Mobile equipment must have external identification signs that allow remote visualization;**
- g) **The use of manned mobile equipment without cabin is not permitted;**
- h) **All mobile equipment must have laminated front windshields, tempered with safety film or polycarbonate, approved by the manufacturer or by the Vale Engineering area;**
- i) For night operations and/or in low visibility conditions, and whenever the standard lighting of the equipment is not efficient, auxiliary lighting approved by the manufacturer or the Engineering area must be used;
- j) Mobile equipment owned by Vale or at Vale's service must have an audible reverse gear alarm. It is not necessary to use it on public roads or close to Vale's neighboring communities
- k) Loads carried on trucks, which may move, displace or tip over, must be tied, secured or contained, except for bulk ore loads, which must be evenly distributed;
- l) **All mobile equipment must receive the preventive maintenance recommended by the manufacturer;**
- m) **Modifications to mobile equipment must only be performed after formal approval by the manufacturer.**

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3.6.3 Specific requirements according to mobile equipment:

Specific Requirements	Graders	Scrapers	Wheel Loaders	Backhoes	Excavators	Tractors	Forklifts	Tire Handlers	Drills	Haul trucks	Other Trucks
a) Safety belt 03 points.										X ^(a)	X
b) Safety belt 02 points.	X	X	X	X	X	X	X	X	X		
c) Rollover Protection Structure (ROPS).	X	X	X	X	X ^(b)	X				X	
d) Falling Object Protection Structure (FOPS).	X	X	X	X	X ^(b)	X				X	
e) Windshield Protection Grid (FOG).			X ^(c)	X ^(c)		X ^(c)					
f) Escape and landing alternatives in emergency situations.	X	X	X	X	X	X				X	
g) Proximity alert system between equipment.	X ^(e)	X ^(e)	X ^(e)	X ^(e)						X	X ^(e)
h) Anti-collision system with automatic equipment braking.										X	
i) Front video cameras.										X	
j) Rear video cameras.			X ^(d)		X ^(d)	X ^(d)			X ^(d)	X ^(d)	
k) Sides video câmeras.					X ^(d)	X ^(d)			X ^(d)	X ^(d)	
l) Air-conditioned cabin.	X	X	X	X	X	X	X ^(g)	X	X	X	X
m) Two-way communication radio.	X	X	X	X	X	X	X	X	X	X	X ^(e)
n) Location and speed (telemetry) monitoring systems.										X	X
o) Load monitoring systems.										X	
p) Tire pressure and temperature monitoring systems.			X ^(d)							X	
q) Traction on at least two axes when there are 3 or more axes.											X ^(e)
r) Reflective stickers on sides and rear.							X	X			X
s) Reverse warning light.	X		X			X ^(f)	X	X		X	X
t) Speed limiting device.							X	X		X	
u) Operator presence detection system.							X	X			
v) Fixed load table next to the commands.			X	X	X		X	X			
w) Primary auxiliary braking system speed retarding (engine brake) and secondary auxiliary braking system (hydraulic retarder + electromagnetic)											X ^h
x) Head rest.											X
y) Tilt position indicator (visual and audible on panel).										X	*
z) Low tilt physical indicator.										X	
aa) Signaling devices (reflective triangles, cones, plastic drums or stanchions).											X
bb) Operator drowsiness detection system.										X	X ^(e)
cc) Hydraulic actuation of fork opening and closing.							X ^(g)				

(a) Mandatory for the operator

(b) Mandatory for 6 to 50 tons excavators

(c) Mandatory for mobile equipment used in vegetable clearance and demolition

(d) Required for large equipment

(e) Required for mining operations only

(f) Required for tire tractors

(g) Not required for electric pallet trucks and electric forklifts

(h) The Secondary Auxiliary Braking System (hydraulic retarder + electromagnetic) is mandatory for equipment with a total gross weight equal or above 30 tons and its use on long and steep slopes.

(*) See item 3.6.3.— dd

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dd) All road-type dump trucks that have internal mechanisms to drive and lift the implements (bucket, board, vacuum, among others) located inside the cab must have:

- I. Elevated/high tilt position indicator (visual and audible in the panel);
- II. **Travel speed limiter of the equipment in the raised tilt condition;**
- III. Inclinator.

3.6.4 General requirements for underground mining equipment:

- a) Safety belt;
- b) Falling Object Protection Structure (FOPS);
- c) **Roll Over Protection Structure (ROPS);**
- d) **Auxiliary lighting, approved by the manufacturer or engineering area, in addition to standard equipment lighting;**
- e) Audible reverse alarm;
- f) **Reverse warning light;**
- g) **Escape and landing alternatives from the equipment in case of emergencies;**
- h) Two-way communication radio;
- i) **Traction in at least 02 (two) axes;**
- j) Safe braking system (service, parking and emergency brakes) independent of equipment engine operation.

3.6.5 Specific requirements according to mobile underground mining equipment:

Specific Requirements	Graders	Wheel Loaders	Low Profile Loaders	Excavators	Underground Drills	Scalers	Telescopic Handlers	Rigs	Articulated Trucks (haul trucks)	Scissors lift trucks	Other trucks
a) Windshield Protection Grid (FOG).				X							
b) Front video cameras.			X								
c) Rear video cameras.		X	X						X		
d) Air-conditioned cabin.	X	X	X	X		X	X		X	X	X
e) Location and speed monitoring systems (telemetry).									X	X	X
f) Reflective stickers on sides and rear.	X			X	X	X	X	X	X	X	X
g) Speed limiting device.									X		
h) Fixed load table next to commands.		X	X	X							
i) Primary auxiliary braking system (engine brake) and secondary auxiliary braking system (hydraulic retarder + electromagnetic)									X ^(a)		X ^(a)
j) Head rest.	X					X			X	X	X
k) Signaling devices (reflective triangles, cones, plastic drums or stanchions).											X
l) Operator drowsiness detection system.									X	X	X

(a) The Secondary Auxiliary Braking System (hydraulic retarder + electromagnetic) is mandatory for equipment with a total gross weight equal or above 30 tons and its use on long and steep slopes.

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3.6.6 Requirements for fire detection, mitigation and prevention on mobile equipment:

- a) Mobile equipment with a cabin floor with height of 1.80 meters or above must have:
 - I. Automatic fire detection and suppression systems sized according to the size of the equipment and recommended by manufacturer of the system or approved by the Engineering Department;
 - II. Thermal blankets over hot parts subjected to the projection of flammable liquids (ex. exhaust ducts, turbines and silencers);
 - III. Diffuser valves for relieving internal tire pressure (wheels with diameter $\geq 39"$);
 - IV. Evacuation system the enables the operator to safely evacuate the equipment in the event of equipment fire, homologated by Vale's engineering areas;
 - V. Automatic and emergency engine shutdown logic in case of activation of the fire detection and suppression system (shutdown).
- b) Mobile underground mine equipment must have fire suppression systems with automatic detection and manual activation from the cabin and at floor level, with the exception of rigs and trucks with a payload of up to 4 tons;
- c) Automatic fire detection and suppression systems on mobile equipment must be maintained, inspected and available for use;
- d) In addition to automatic fire detection and suppression systems, portable fire extinguishers recommended by the manufacturer must be available on mobile equipment;
- e) Large water trucks must have automated water monitors to support firefighting on mobile equipment.

3.7 Procedural requirements

Local procedures must be implemented in all operational areas that have mobile equipment circulation and these must include, in synergy with the operational area Traffic Plan:

- a) Access control of mobile equipment, motor vehicles and people to the mining areas;
- b) Definition of restricted areas (exclusion zones);
- c) External circulation;
- d) Operation outside the Vale site/area;
- e) Telemetry management including:
 - I. System for periodic and routine verification of the information available;
 - II. Consequence Policy in cases of violations.
- f) Management of drowsiness detection systems including:
 - I. System for periodic and routine verification of the information;
 - II. Reporting of abnormal cases;
 - III. Actions to be taken in case of deviations.
- g) Tire pressure and temperature monitoring management, including:
 - I. System for periodic and routine verification of the information;
 - II. Actions to be taken in case of deviations.
- h) Pre-use and periodic inspections;
- i) Equipment checks and tests for release before first use and after maintenance, including brake testing according to the manufacturer specifications;
- j) Gas emission test in underground mining equipment;

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- k) **Mandatory use of Tire Handlers to handle tires with an outside diameter of 1350 mm or greater;**
- l) **Operational conditions of automatic fire detection and suppression systems in mobile equipment;**
- m) Mobile equipment towing complying with the following priority:
 - I. Use of tow truck;
 - II. Use of float truck;
 - III. Use of drawbar, approved by the Vale Engineering Department, only when the equipment has steering and brake systems in perfect working order
- n) Mobile equipment removal, complying with local procedures that contain, at a minimum:
 - I. Formal documented planning with risk analysis;
 - II. Use of fiber cables with anti-whipping properties approved by Vale's Engineering area;
 - III. Pre-use inspection of mobile equipment and towing accessories following applicable technical standards;
 - IV. Detailed periodic inspection of towing and rigging accessories in accordance with manufacturers' specifications and as provided for in local legislation; and
 - V. Checks, tests and approval of equipment and accessories in the acquisition / contracting process before the first use.
- o) Utilization of chocks¹⁷ compatible with the tire dimensions of the mobile equipment and its implements and in sufficient numbers to block its movement in the following situations:
 - I. **In maintenance performed in workshops or maintenance stalls;**
 - II. **In activities where the equipment must remain switched on and the operator must stay outside the cab, except in shift changes, which must take place at appropriate and safe locations for this activity;**
 - III. **In parking lots;**
 - IV. **In case of mobile equipment that is damaged or needs to be temporarily parked on roads, access roads or sloped roads, with the operator outside the cab.**
- p) **Manual positioning of excavator power cables, including the following:**
 - I. **They must be supervised by an Electrician (instructed professional) carrying a two-way communication radio (exclusive channel);**
 - II. **They must only be performed if the Operator of the excavator maintains eye contact with all persons performing the activity;**
 - III. **They must only be carried on in good visibility conditions;**
 - IV. **They must be interrupted during thunderstorms or risk of lightning;**
 - V. **They must be performed under the condition of zero energy in case the cable is submerged by water and/or mud.**
- q) **Mobile equipment in traffic under energized and non-insulated power lines at a distance of less than 6.0 meters, must be performed under the supervision of an Instructed Electrical Person and a Mine Operation Technician, who must have two-way radio communication with the Operator of the equipment;**
- r) **Equipment headlamps must be turned on during operation of the equipment, except on external roads when not permitted by local law;**

¹⁷ The use of chocks is not mandatory when the equipment is on the outrigger floats or when the implement is lowered at ground level, which prevents its involuntary movement.

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- s) As long as the equipment is not parked in a safe place, the use of TV/DVD devices, headphones/earphones, and mobile phones, including headset or speakerphone features, is prohibited;
- t) People circulating in operating routes and mining areas must wear reflective clothing or waistcoats;
- u) People in underground mining areas must wear reflective adhesive hardhats;
- v) All Vale Sites must have a Traffic Plan that includes the basic elements described in Annex I;
- w) All operating routes must be considered in the operational area Traffic Plan.

3.8 Training requirements

Mobile equipment operators must have:

- a) Valid driver's license for the type of mobile equipment they will operate, when required by local law;
- b) Certification for the operation of the specific equipment type;
- c) RAC 03, including retraining, according to Valer guideline;
- d) **Training in the operation of the automatic fire detection and suppression systems, evacuation techniques and activation of the site emergency plan, if operating mobile equipment with such systems.**

3.9 Roles and responsibilities

3.9.1 Leader of each location/site (Supervisor, Manager, or Director):

- a) Implement the local Traffic Plan;
- b) Implement the equipment requirements of this RAC;
- c) Implement the specific procedures described in this RAC;
- d) Approve modifications or the inclusion of safety accessories in the mobile equipment.

3.9.2 Leader of each operation/project (Supervisor, Manager or Director):

- a) Document the inventory of mobile equipment in use at Vale's service in the location, whether by his own employees or contractors;
- b) Document the inventory of operators authorized to operate mobile equipment, with the following information:
 - I. Type of mobile equipment;
 - II. Category and expiration date of the license;
 - III. Date of issue of certification for operation on the specific equipment type and date of next refresher course;
 - IV. Date of training in the traffic plan of the current operational area and CAR 03 training, including refresher courses.

4. RAC-04 – LOCKOUT, TAGOUT AND ZERO ENERGY

4.1 Foreword

A significant proportion of harm to people and reporting of high-potential incidents occurring within Vale included cases when the energy sources were not properly locked out. The main contributing factors were associated with:

- a) Inadequate or non-existent application of lockout and tagout;
- b) Inadequate or non-existent zero energy test;
- c) Absence of a lockout procedure or a procedure that did not identify the requirement to lockout;
- d) Inadequate or non-existent lockout method/procedure;
- e) Gaps in the qualification process;
- f) Replace inadequate or non-existent of the protection devices or of the guarantee of integrity of security conditions;
- g) Inadequate or non-existent work planning/scheduling;
- h) Inadequate or non-existent communication among work groups;
- i) Inadequate or non-existent lockout of potential gravitational energy source;
- j) Inadequate or non-existent temporary change of zero energy state.

4.2 Purpose

To define the Health and Safety requirements to be applied for effective control of the risk of harm to people and eliminate involving the release of hazardous energies.

4.3 Application

Maintenance activities and services involving processes and equipment where procedures are required for isolation and lockout / tagout of energy sources that ensure the control of potential release of hazardous energy.

4.4 Exceptions

The requirements of this RAC do not apply to:

- a) Activities in machinery, equipment and installations where safeguards ensure effective protection of workers from exposure to hazardous energies created by an unexpected energy release and workers do not expose any part of the body to the danger zones associated with the operation of machinery, equipment or installations.
- b) Equipment which can be de-energized by unplugging from an electrical outlet, when the person doing service or maintenance has exclusive control of the plug (working alone) and the electricity is the only energy source present.
- c) Disassembly, removal and assembly of parts of machines, equipment and systems that are steps inherent to the maintenance process. The risks created by any movement of these parts by disassembly, removal or assembly must be dealt with by specific maintenance procedures or SWP - Safe Work Permit.

4.5 Important definitions

- **Chemical energy:** Energy contained at a molecular level within a chemical substance. It is a measure of the substance's capacity to transform into another substance through a chemical reaction subsequently releasing, or absorbing, energy.
- **Electrical energy:** Energy from flow of electrical current as a result of a potential difference between two points in an electrical field.
- **Energized:** Connected to an energy source or containing residual or stored energy.
- **Energy source:** Any electrical, hydraulic, pneumatic, chemical, mechanical, nuclear, gravitational, residual, thermal energy.

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- **Exclusive lockout:** Management of work on equipment or a process is transferred solely to one service team for exclusive control of the isolation, lockouts and work without any other party being allowed to access the process / equipment until it is released by the workgroup. (This is performed where there is increased risk caused by simultaneous activities.)
- **Gravitational energy:** Energy of an object (at rest or in motion) exerted by the gravitational pull of the earth.
- **Hazardous energy isolation:** Is the act of removing, disconnecting and preventing inadvertent restoration of energy. It includes the removal and disconnection of energy sources, discharge of residual energy, blocking and / or locking, labeling and testing of the removal or disconnection of hazardous energy.
- **Hazardous energy treatment:** It is the action by specific methods to prevent a hazardous energy from hurting people, when the isolation of the energy is not possible.
- **Hazardous energy:** Potential energy that if released can result in significant harm.
- **Hydraulic energy:** Is the energy stored within a pressurized liquid. When under pressure, the fluid can be used to move heavy objects, machinery, or equipment.
- **Isolation devices:** A Device that is capable of isolating an energy source, such as sectioning keys, valves, dampers, switches, circuit breakers, etc.
- **Local standards:** Formal regional / industrial/ legislated requirements applicable to the operational area that are to be reflected in local procedures.
- **Lockout devices:** A mechanical means of locking equipment or system energy source isolation devices that prevents machinery or equipment from becoming energized.
- **Lockout matrix:** A formal means of identification of energy sources and lockout points associated with machinery, equipment, system or facility isolation.
- **Lockout of hazardous energies:** The application of specific isolation requirements to prevent harm as a result of being exposed to an uncontrolled release of energy. This may occur with the unexpected activation of machinery and equipment or release of hazardous energy during maintenance or service activities.
- **Mechanical energy:** Is the energy transferred by means of a force on an object through a distance, or an object in motion.
- **Pneumatic energy:** Energy produced from compressing air within an enclosed system.
- **Radioactive (or nuclear) energy:** Energy produced as a result of a fission or fusion reaction during the molecular transformation of unstable atomic nuclei.
- **Residual energy:** Accumulated energy remaining when energy sources to a system are turned off. Left undissipated residual energy can result in significant harm and therefore must be tested, and where present, eliminated so that a zero energy state is obtained.
- **Tag:** Individual warning card fastens on the equipment requiring isolation, lock and tagging and includes name, date, time and reason for lockout.
- **Team:** Group of people involved in performing a activity independent of the company or specialty.
- **Thermal energy:** Energy generated by the kinetic energy of the atoms of a substance.
- **Visitor:** A person that, although not being directly involved in activity related to the process lockout must also apply individual lockout device(s).
- **Zero energy state:** An energy level that is so low that it cannot result in harm.

4.6 Requirements for installations and equipment

- a) Processes (including machinery) and equipment within an operating facility must be clearly identified, formally documented and the energy isolation devices must be capable of being locked out;
- b) Isolation devices must be clearly identified in area process and referenced in isolation procedures. Isolation devices must be, preferentially, designed as permanent physical installations;
- c) Process flow, instrumentation and electrical drawings must be up-to-date, so that isolation points can be referenced and clearly identified in process isolation procedures;
- d) Lockout devices must:
 - I. Be durable to withstand the environment in which they are used;
 - II. Be designed to directly enable the use of locks;
 - III. Have mechanical integrity that does not enable tampering;
 - IV. Meet format requirements of local standards.
- e) Locks must:
 - I. Be designed for energy isolation lockout purposes and have at least 6 pins;**
 - II. Be single keyed and combination locks are prohibited;
 - III. Be designed to retain the key when the lock is open;**
 - IV. Be constructed of nonconductive material where there is the possibility of contact with electrically energized surfaces.**
- f) Lockout tags must:
 - I. Be durable to withstand the environment in which they are used;
 - II. Be traceable;**
 - III. Indicate the name of person, date, time and reason of lockout;
 - IV. Follow the format requirements of local standards.
- g) Any process (including machinery) and equipment supplied by electrical energy where isolation devices are located in sub stations, electrical rooms or motor control centers must have a formally implemented system to manage the isolation and lockout of electrical energy stages through the:
 - I. Identification of all energy paths connected to equipment that must be isolated;
 - II. Compliance with all requirements of lockout/tagout and of removal of locks.

4.7 Procedural requirements

- a) Each location must have defined and implemented lockout and tagout procedures that include, at a minimum:
 - I. Identification of hazards and required controls;**
 - II. Responsibilities, accountabilities and approvals;**
 - III. Method(s) which the person(s) that working under the isolation will use to install his/her (their) lockout and tagout devices, i.e., directly on the isolation devices themselves or in a box which contains the key of the locks installed by the authorized person(s) who performed the lockout/tagout in the isolation devices;**
 - IV. Lockout process stages and steps to be taken including:**
 - Identification of equipment to be locked out;
 - Process to check that all energy sources are properly identified;
 - Isolation of energy sources;

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- Release of residual energy, including steps to sustain a zero energy state;
 - Application of lockout and tagout in each energy source;
 - Verification process to evaluate that zero energy has been achieved.
- V. Steps to be followed for changes and shift handover, following the requirements established in this document.
- b) **A lockout matrix is to be defined for each process / equipment lockout to be performed which includes, at a minimum, identification of all energy sources and isolation devices;**
- c) Prior to initiating any activity, each person working under the isolation must install their own individually keyed lock and individual tag when locking out devices. No one is to attempt to remove any protection lock other than themselves;
- d) No one is to attempt to damage or violate any lockout device applied in machinery, equipment and facilities;
- e) Any person working under an isolation process must verify zero energy is made before starting their activities, as defined in local procedures;
- f) Where it is not possible to obtain zero energy state, a specific procedure must be developed using a hazard analysis approach to define effective controls that eliminate exposure to hazardous energies and must be approved by the area manager;
- g) **Additional control must be implemented for equipment that has the potential to reaccumulate energy during the performance of activity;**
- h) **Machines or equipment under maintenance or service and which have moving or rotating parts supported by cables or by hydraulic cylinders such as counterweights, pelletizing discs, bucket wheels, truck cabins, etc. that can move through the action of potential gravitational energy must have this risk situation identified in the lockout matrix and properly isolated and locked according to the local procedure in order to prevent unwanted movement;**
- i) **An authorized professional must be designated to verify that all necessary locks and tags have been correctly performed or installed if more than one team is engaged in activities on the same locked equipment;**
- j) **Criteria and guidelines for execution of exclusive lockouts must be defined in local procedure. Equipment whose any intervention may generate risks to other teams should be under exclusive lockout, prohibiting performance of simultaneous activities on this equipment while the exclusivity lasts;**
- k) **For tasks requiring a change of zero energy state, with the temporary introduction of power for testing on machines, equipment, or installations under isolation these steps must be followed:**
- I. **Exclusive lockout of the machine, equipment or installation;**
 - II. **Risk analysis associated with the temporary change;**
 - III. **Application of the required control measures according to the local procedure;**
 - IV. **Communicate the change to all people working under the lockout;**
 - V. **Interruption of the work of all people working under the lockout who are not directly acting on tests that require the temporary introduction of energy;**
 - VI. **Temporary change in lockout;**
 - VII. **Confirmation by the authorized professional that all required control measures have been correctly applied;**
 - VIII. **Conducting the tests;**

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- IX. Return the machine, equipment or installation to its previous zero energy condition by removing the temporarily introduced energy and returning the disconnecting devices to their position as originally locked;
 - X. Confirmation by the authorized professional that the lockout has been returned to its original zero energy condition;
 - XI. Communication of the return of the lockout to all people who are working at the machine, equipment or installation under the isolation;
 - XII. Resumption of jobs originally planned under the isolation.
- l) To address the removal of a lock where the key cannot be found or where the lock owner is absent from work and cannot be contacted, a special authorization must be granted by the area manager as established in local procedure, including the analysis of the risks involved;
- m) Procedures for the removal of locks and tags for re-energizing the isolated system must include, at a minimum:
- I. Confirmation that all involved parties concluded their activities and are permanently out of the risk area;
 - II. Confirmation that all tools and parts were removed from the risk area;
 - III. Confirmation that all mechanical or electric protection mechanisms, individual or collective ones, were returned to their original condition.

4.8 Training requirements

- a) People involved in activities or tasks that require lockout/tagout must be trained in RAC 04, including retraining, according to Vale's guideline

4.9 Roles and responsibilities

4.9.1 Executive Officers or Managements:

- a) Formally designate one or more persons responsible for developing and maintaining the following processes / procedures / controls:
 - I. Lockout and tagout process;
 - II. Lockout matrix;
 - III. Formal implemented system to manage the isolation and lockout of hazardous energies stages for any process (including machinery) and equipment supplied by electrical energy where isolation devices are located in sub stations, electrical rooms or motor control centers;
 - IV. Training and evaluation program for employees involved in the isolation of hazardous energy, lockout and tagout processes including testing for residual energy;
 - V. Program for verifying the effectiveness of the implementation of the requirements described in this document;
 - VI. Ensure the necessary resources for the implementation of hazardous energy control.

4.9.2 Managers:

- a) Approve safety operating procedures containing control measures that eliminate exposure to hazardous energy when a zero energy state cannot be achieved on a given equipment, installation or system;
- b) Formally approve employees authorized to perform hazardous energy lockout;
- c) Formally designate one or more persons responsible for confirming that all necessary locks have been correctly performed if there is more than one team involved in activities on the same locked equipment.

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4.9.3 Employees involved in hazardous energy blocking processes:

- a) Exercise the right of refusal when irregularity in the lockout and tagout process is identified;
- b) Comply with the requirements established in this document and in local procedures.

4.9.4 Any employee (Vale, Contractor or Other):

- a) Exercise the right of refusal when irregularity in the lockout and tagout process is identified;
- b) Comply with the requirements established in this document and in local procedures.

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5. RAC 05 – LIFTING OF LOADS

5.1 Foreword

A significant proportion of critical incidents in Vale occurred during the lifting of loads. The main contributing factors associated with these incidents were:

- a) Use of inappropriate tool / equipment;
- b) Inadequate position for the task;
- c) Failure to alert / warn / communicate;
- d) Improper loading / tethering;
- e) Failure to identify and assess risks;
- f) Unintentional deviation from working standards (error);
- g) Lack of risk perception / awareness;
- h) Defective / inappropriate tool / equipment;
- i) Inadequate lifting / lifting;
- j) Failure to perceive the risk situation.

5.2 Purpose

Establish requirements for lifting loads at Vale.

5.3 Application

Activities associated with the lifting of load by equipment owned, leased or rented by Vale, including service provider lifting equipment that are part of a contract scope with Vale, from the following types of lifting equipment: cranes, overhead cranes, monorail lifting systems, lifting booms, mobile cranes, hoist and any other lifting equipment or lifting system¹⁸.

It is understood in the scope of the activity of lifting the preparation and modifications made to the equipment and the load to be lifted.

5.4 Exceptions

The requirements of this RAC do not apply to:

- a) Load transport activities by vehicles or equipment; Example: transport by trucks, trailers, forklifts, etc.
- b) During the maintenance¹⁹ of load lifting equipment while not in use for lifting, except when, in the maintenance activity there is load lifting;
- c) Operation of vehicles designed for lifting loads without being in the lifting activity;
- d) People lifting activity

¹⁸ Even it is not listed in this document, any equipment for lifting of load (adapted excavators, for example) of load must comply with the general requirements (not specified for a type of equipment) of this RAC.

¹⁹ The responsible for the lifting equipment handling during the maintenance activity must be properly qualified to operate the equipment, this qualification must enable the responsible for maintenance to ensure the minimum knowledge required for handling and equipment tests.

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5.5 Important definitions

- **Accessories:** shackles, synthetic webbing slings, chain slings, wire ropes, forged fittings and special devices.
- **Factor or utilization rate:** is the ratio between the gross load of the crane to be hoisted and its capacity according to its load chart and configuration.
- **Critical Lifting:** Any lifting that has at least one of the mandatory conditions for the elaboration of a Rigging plan (see item 5.7 - Requirements for procedures, letter 'f').

5.6 Requirements for installations and equipment

5.6.1 General requirements for installations and equipment:

- Visible indication of the maximum load handling capacity on lifting accessories and equipment;
- Hooks with safety locks on load lifting equipment;
- Load lifting accessories must comply with national and/or international regulatory requirements.**

5.6.2 Specific requirements according to equipment:

Specific Requirements	Tower Crane	Vehicle-mounted crane	Other Cranes	Overhead Crane	Monorails ²⁰	Electric Hoist	Manual Gantry
a) Load table fixed next to the control Levers	X	X	X				
b) Movement sound alarm	X			X		X ²¹	
c) Top lights	X						
d) Grounded structures	X			X	X	X	
e) Outriggers pressure monitoring			X				
f) Outriggers leveling checking system or device		X	X				
g) Extensions and outriggers with hydraulic drive		X	X				
h) End stop limit switch (stopping the equipment when the limit is exceeded)	X		X	X		X	
i) Sensor or device that identifies the loose cable				X		X	
j) Anti-collision sensors ²²				X			
k) Remote control (Joystic) for load movement		X					
l) Inclinator that prevent lifting of load with improper cable angulation				X			
m) Boom with hydraulic drive		X					
n) Locking casters							X

²⁰ The requirements for the monorail are for the structure itself. Equipment (such as trolley with a hoist) that will be supported on the monorail must comply with their specific requirements.

²¹ Except for fixed hoist.

²² Only for two or more overhead crane in the same interspace.

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Specific Requirements	Tower Crane	Vehicle-mounted crane	Other Cranes	Overhead Crane	Monorails ²⁰	Electric Hoist	Manual Gantry
o) Anemometer	X		X ²³				
p) Emergency button	X	X	X	X		X	
q) Overload sensor, with stop of equipment and audible/visual alarm when rated capacity is exceeded		X	X	X		X	
r) Winch safe brake system	X			X		X	

5.7 Requirements for procedure

- a) Isolation of the lifting area must be implemented considering:
 - I. The perimeter of the load travel;
 - II. The boom of the equipment operating area, for boom for cranes;
 - III. The outrigger distance, for equipment with outriggers stabilization.
- b) The use of plastic zebra tape for area isolation is prohibited;
- c) Where lifting activities take place over equipment and facilities, the isolation must take into consideration the magnitude of an unwanted event based on the fall of the load and the consequent collapse of the structure below;
- d) Where radio communication is used (between an operator and signalman), it must take place using an exclusive radio frequency;
- e) Local procedure(s) must be defined which include, at a minimum:
 - I. Pre-use inspection of lifting equipment and accessories, (in accordance with the requirements of the respective applicable standards);
 - II. Detailed periodic inspection of lifting accessories in accordance with manufacturers specifications and local legislation;
 - III. Verifications, tests and approval of equipment and accessories at the time of acquisition / procurement before first use.
- f) A Lifting Plan (Rigging²⁴ Plan) must be developed according to the minimum established in annex II of this document and for critical lifting with crane on wheels/mat, articulated vehicular crane and crane. A Rigging plan should be drawn up if any of the items below apply to lifts:
 - I. Applied to any lift exceeding 10 tons;
 - II. Total load equal to or greater than 75% of the maximum capacity of lifting equipment, based on the limits of the loading table to the corresponding distance;
 - III. Where two or more cranes or forms of lifting equipment is involved;
 - IV. Proximity to power lines or buss bars;
 - V. Loads with large and irregular shape;
 - VI. With onboard cranes.
- g) The minimum content of the rigging plan must follow Annex II to this document;

²³ Only for cranes with capacity above 75 ton.

²⁴ Rigging Plan is considered a specific type of formal and documented planning, with the minimum content established in this document. Lifting activities that do not require a Rigging Plan must also be planned and undergo a risk analysis.

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- h) The maximum capacity of any lifting equipment or device must not be exceeded;
- i) **In disassembly activities, when a crane is used to support a high load during the removal of its support points in the structure where it is mounted, the limit of 70% of the operation utilization factor must be adopted;**
- j) Defective and/or worn lifting accessories must be discarded and disposed of permanently;
- k) Outriggers of cranes must be fully extended for all lifting activities, regardless of the weight of the load;
- l) **When not defined in the Rigging Plan, the pads of outriggers must be shimmed with a slab area of at least twice as large as the pad area;**
- m) It is strictly forbidden for people to directly stabilize (touch) a suspended load. Instead, guide cables must be used whenever stabilization is required;
- n) It is strictly forbidden to place people under a suspended load, considering the risk of falling and movement;
- o) **It is forbidden to access an isolated area for load lifting without proper authorization;**
- p) **Lifting loads using improvised or adapted equipment (forklift adaptation, for example) not manufactured or designed for this purpose is prohibited, except with the express permission of the manufacturer.**
- q) **The load to be lifted must be properly hitched according to its type, dimensions, weight and the type of accessory/equipment to be used.**

5.8 Training requirements

- a) Equipment operators must have:
 - I. Valid qualification for driving and operating equipment when required by local law;
 - II. Certification for operation of specific load lifting roles and lifting equipment operators, the latter including training for each major type of equipment.
- b) The employees or third parties responsible for preparing the Rigging plan must have:
 - I. Certification for elaboration of the Rigging plan;
- c) Operators of equipment, signalers and helpers of the lifting activity must have training in RAC 05, including retraining, according to Vale's guideline

5.9 Roles and responsibilities

5.9.1 Contract manager:

- a) Ensure all CAR requirements are implemented in his/her areas;
- b) Follows the services suppliers' safety performance and requirements accomplishment;
- c) Participate in any investigations related to incidents (N1 and N2) involving load lifting activity.

5.9.2 Maintenance Planning and scheduling²⁵:

- a) Need to know the CAR requirements applicable to his/her areas and ensure that risk analysis for load lifting are initiated on his/her work process steps;
- b) Provide basic data - identification, weight and dimensions - about the load to be lifted.

5.9.3 Rigging supervisor:

- a) Coordinate, guide and follow all steps (mobilization, operation and demobilization) related to the load lifting activities that are covered by Rigging Plans.
- b) Follows all CAR's requirements RAC and in line with the calculations and requirements of the Rigging plan.

²⁵ Maintenance, infrastructure and projects.

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5.9.4 Load lifting focal point:

- a) Skilled and formally assigned to act as technical representative to work with the load lifting service providers prefects.

5.9.5 Tool shop supervisor and/or resources (materials) responsible (professionals in charge to manage the work at height equipment and devices:

- a) Ensure that all devices for work load lifting are inspected on receiving step, as well as, periodically;
- b) Set the inspection plan including frequency according to related regulatory requirements.
- c) Segregate and send for disposal all equipment and device in nonconformance condition.

5.9.6 Maintenance engineering:

- a) Indicate the professional designated to perform load lifting activities in his/her area to identify and elaborate the procedures for the following situation: verticalization / horizontalization / tipping operations of common loads in workshops or in the field and activities where the entry and / or stay of persons within the isolation area is required when the load is still supported by the hoisting equipment (see item 5.7 - Requirements for procedures, letter 'o').

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6. CAR-06 – CONFINED SPACES:

6.1 Foreword

A significant proportion of critical incidents in Vale occurred in confined spaces . The main contributing factors associated with these incidents were:

- a) Lack of risk perception
- b) Inappropriate/missing/tool/equipment/device
- c) Misunderstood information/instructions/training

6.2 Purpose

To establish minimum Health and Safety requirements to recognize, identify, assess, control, mitigate, and monitor existing risks in jobs where workers directly or indirectly interact with these confined spaces, to eliminate and/or minimize high-potential events, as well as develop responses to emergencies that may occur involving confined spaces.

6.3 Application

The requirements for this CAR are applicable for accessing and/or performing activities in confined spaces.

Access to confined spaces, as well as the activities to be carried out in these locations, are considered critical in view of the risks related to the atmosphere in these areas, as well as the other risks inherent to the activities to be performed.

Confined space activities should be preceded by planning and, when possible, the adoption of alternative means to avoid worker exposure to these environments. Therefore:

If possible, the location must opt for an engineering solution that eliminates the exposure of workers to hazards in confined spaces. When planning entry into confined spaces, you must evaluate whether entry is absolutely necessary or whether the activity can be performed without exposing workers to the risks inherent in confined spaces.

When the entry of people into confined spaces is mandatory due to technological limitations, the monitoring process during entry must be carried out using highly reliable remote monitoring technologies.

6.4 Exceptions

Confined spaces must be classified according to the requirements and premises defined by local legislation. Therefore, it is not a question of establishing exceptions, but of providing a pertinent characterization of confined spaces.

6.5 Important definitions

Confined spaces: This definition must meet local regulatory and legal requirements, as it is recognized that the definition may differ considering the presence of Vale S.A. in several countries around the world.

Locations that do not have local regulatory and legal requirements regarding confined spaces must define the alignment of their requirements in accordance with the Vale Corporate Health, Safety and Operational Risk advise.

6.6 Requirements for installations and equipment

- a) Confined spaces must have identification plates, physical barriers with locks in order to prevent unauthorized access and access controls to advertise and prevent inadvertent or unauthorized access to confined spaces.
- b) All devices, tools and equipment to be used in activities in confined spaces must be previously inspected, including that support equipment that will not be inserted into them.
- c) Maintenance and inspection plans must be implemented according to the specifications of the manufacturers or Vale's maintenance areas to provide (a) the reliability and useful life of the atmospheric monitoring equipment, (b) rescue in confined spaces, and (c) reliability of the individual specific protective equipment (e.g., supplied air equipment) and collective protective equipment.
- d) The equipment data and its inspection and maintenance plans, described in item "c"., must be registered and kept updated in a system for user consultation.

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- e) Multigas meters, oxy explosimeters and all other equipment that requires calibration must be properly calibrated and tested (via a bump test) before being used.
- f) It must be implemented exhaust systems – that is, an air supply with an alarm – must be installed in case of failure.
- g) Breathing air supply systems must meet the requirements of the:
 - I. Local regulatory and legal regulations.
 - II. The respiratory protection program.
- h) Emergency response equipment must be available, including a first aid kit, confined space rescue gear, height rescue, and supplied air and autonomous breathing apparatus.
- i) Use of safety devices for electrical equipment or devices (such as, for example, a residual current devices) must be provided in accordance with local regulations.
- j) In hazardous areas with explosion potential, electrical equipment and devices must be assigned and certified for these areas.

6.7 Requirements for procedure:

6.7.1 Requirements for planning of entry in confined spaces:

- a) Entries into confined spaces must be previously evaluated and carefully planned and scheduled to include risk analysis and procedures covering the steps of:
 - I. General procedures for confined spaces.
 - II. Preparation procedures for entry into confined spaces.
 - III. Confined space entry procedures.
 - IV. Task procedures and activities to be performed in confined spaces.
 - V. Emergency procedures in confined spaces.

6.7.2 General requirements for general procedures for confined spaces

- a) There must be an updated inventory of confined spaces, including deactivated (out of operation) ones, with their respective risks.
- b) Units must establish and maintain a system of periodic inspections providing for at least the maintenance of identification plates, cleaning and maintenance of accesses to their inventoried confined spaces.
- c) Areas of access to confined spaces must be isolated and signaled during work in order to aware and prevent unauthorized access

6.7.3 Requirements for preparation procedures for entry into confined spaces

- a) Entry into confined space must be carried out after the space has been adequately prepared following a specific procedure to control all the risks that could impede activity there.
- b) The confined space preparation procedure must be specific and elaborated in a checklist-like format.
- c) The confined space preparation process must involve the steps of cleaning, decontaminating and ventilating prior to any entry into the space.
- d) The specific procedure for preparing for confined space entry should include:
 - I. Choose the method of isolating the equipment for entry into confined space from the options below (and in the following order of preference):
 - Physical disconnection,
 - Installation of isolation devices/spectacle blind

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- Double block and drain (double block and bleed) application²⁶.
- II. Ensure that all energy sources are isolated, blocked, tagged and verified according to CAR 4 requirements.
- III. Monitor atmosphere/air quality (initial and periodic) to ensure airborne concentrations remain within acceptable concentrations.
- IV. Identify and calibrate the meter for monitoring the atmosphere (calibration procedure for air quality measuring instruments).
- V. Eliminate flammable / combustible materials in the area and verify this through pre-task inspection and periodic cleaning.
- VI. For external air supply/exhaust systems (with redundant fans), purge or vent spaces prior to entry of workers to ensure contaminants are within acceptable concentrations.
- VII. Prior communication to the rescue team regarding the confined space entry scenario to be performed and the respective activities to be performed in these spaces.
- VIII. Prior assessment of the rescue team regarding the confined space scenario (recognizing, identifying, and addressing opportunities for prior implementation of devices or systems aimed at rescue in an emergency).

6.7.4 Requirements for confined space entry procedures must be specific and include:

- a) Permanent and durable signage on all confined space accesses to inform workers of the danger involved.
- b) A communication system (tested and available) connecting the work team, Confined Space Entry Attendant (safety observer) and rescue team.
- c) Prior notification to ensure rescuers are available, on standby and aware that the confined space entry procedure will commence.
- d) Initial and continuous air quality monitoring to keep airborne contaminants within acceptable limits.
- e) If mechanical ventilation is required to maintain acceptable atmospheric levels, an adequate warning system and exit procedure must also be provided to ensure workers are adequately warned of ventilation failure and are able to safely exit the confined space.
- f) A description of the steps for internal cleaning of waste material.
- g) Installation of physical locks on moving parts (for example, agitator blades).
- h) Installation and use of indoor lighting (intrinsically safe, water and explosion-proof).
- i) Prior and continuous checking of systems, equipment and accessories to supply breathing air according to the respiratory protection program.
- j) Individual and/or collective protective equipment requirements (industrial hygiene).
- k) Protocols for thermal stress, including a work rest regime (industrial hygiene).

IMPORTANT: It is important to emphasize that thermal stress must be evaluated considering aspects such as and among others, heat/cold, humidity and wind. The respective control and mitigation actions should reflect the scenarios where our operations and activities are present across the globe and, therefore, high and low temperature conditions.

- l) Issuance of a Safe Work Permit (PTS in Portuguese) in accordance with PNR-000031.
- m) A communication process to help the team working in a confined space to exit the space due to:
 - I. Any actual or potential failure of work support equipment
 - II. Any non-compliance detected that may impact the health and safety of workers or

²⁶ It must be disregarded for locations where there are legal requirements that consider this option unacceptable.

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III. By notice from the rescue team (for example: if the emergency/rescue response team has to direct its staff to attend to another scenario and, thus, making other activities in confined spaces unfeasible..

6.7.5 Requirements for task procedures and activities to be performed in confined spaces must be specific and include:

- a) A risk assessment and control/mitigation measures related to the task and to the possible interference with other tasks.
- b) Actual and potential impacts to the quality of the atmosphere in the confined space arising from the activity that will be performed (for example, hot work, etc.) and respective prevention and mitigation controls.
- c) Pre-use inspection of all devices, tools and equipment that will be used in the activity to be performed, and disposal of all material or equipment that is defective or damaged.
- d) Use of a residual device in electrical sources.
- e) Explosion-proof, lighting and anti-spark tool best practices (for example, brushless power tools, intrinsically safe devices for hazardous areas as per PNR-000027 Plant Layout Hazardous Area Classification).
- f) Issuance of a Safe Work Permit (PTS in Portuguese) in accordance with PNR-000031.
- g) A communication process to help the team working in a confined space to exit the space due to any failure or non-compliance that could impact the workers' health and safety.

6.7.6 Requirements for emergency procedures in confined spaces must be specific and include:

- a) Written instructions, including inspection of rescue equipment, rescue plan and test rescue plans.
- b) A communication process to help the team working in a confined space to exit the space due to any failure or non-compliance that could impact the workers' health and safety.
- c) An alert system and exit procedure to ensure workers have adequate warning of ventilation failure and are able to safely exit the confined space.
- d) An exit procedure from the unsafe work environment.
- e) Rescue for emergency scenarios involving confined spaces, as well as emergency scenarios associated with activities carried out in confined spaces.
- f) Reference and alignment to PNR-000066 Emergency Response Management

6.8 Requirement for training

- a) Confined space supervisors must be trained in CAR 06 as well as local legal training requirements for work in confined spaces.
- b) Confined space supervisors must be trained in PNR-000031.
- c) Confined space attendant (safety observer) must be trained in CAR 06 as well as local legal training requirements for work in confined spaces.
- d) Workers who will perform task within spaces must be trained in CAR 06, as well as in local legal training requirements for work in confined spaces.
- e) Workers who will perform the task within confined spaces must be trained in the specific procedures that involve their activities, as well as in the CARs and relevant local legal demands.
- f) Authorized employees, confined space attendant (safety observer) and supervisors (or equivalent, in accordance with local legal requirements) must:
 - I. Conduct CAR 06 training,
 - II. Conduct local regulatory and legal training,
 - III. Meet all CAR 06 requirements, and

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IV. Comply with all requirements related to local regulatory and legal training.

6.9 Roles and responsibilities:

- a) Executive area managers (or their designated representatives) must:
 - I. Designate the competent professionals who must approve the general local procedures (General Procedures for Confined Spaces, Procedures for Preparation for Entry into Confined Spaces, Procedures for Entry into Confined Spaces, Procedures for Tasks and Activities to be Performed in Confined Spaces and Procedures for Emergencies in Confined Spaces).
 - II. Designate trained and competent professionals in the regulatory and legal requirements of your location.
- b) The Confined Space Rescue Team must be aware in advance of the activities that will be performed in confined spaces.
- c) Locations must ensure that records are retained in accordance with local regulatory and legal requirements of all training and documents associated with confined space work activities (items a, b, c, d, e, f and g, above).

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7. CAR-07 – MACHINE GUARDING:

7.1 Foreword

Some of the accidents at Vale have occurred during critical activities involving machines with unguarded moving parts. The main contributing factors associated with these accidents were:

- a) Absence of physical protection (fences, shields, etc.),
- b) Absence of automatic protective devices (presence sensors, light curtain, interlocks, controllers, actuators, etc.),
- c) Guards being removed and/or not reinstalled after machine maintenance,
- d) Inadequate safeguarding,
- e) Lack of awareness of machine risks, and
- f) New and existing machines not complying with technical standards for machinery safety.

7.2 Purpose

To establish minimum requirements on machine guarding for acquisition, installation, commissioning, operation and maintenance activities to prevent accidents.

7.3 Applicability

This document applies to all new and existing machines at Vale's facilities and at those of our contractors/third parties, such as:

- a) Fixed or mobile machines and associated installations, both new designs and existing,
- b) Standard machines purchased from suppliers, including those adapted for Vale,
- c) Machines manufactured specifically for Vale, and
- d) Modifications made to existing machines and associated installations.

7.4 Exceptions

The requirements of this CAR do not apply to:

- a) Non-installed parts, components or pieces of interchangeable equipment that by themselves do not constitute a machine (hydraulic units, robots, etc.),
- b) Lifting accessories such as chains, ropes and steel cables,
- c) Partly completed machinery, that are not yet in operation, and
- d) Machinery designed for:
 - I. Nuclear and/or windmill power generation purposes,
 - II. Use onboard seagoing vessels and mobile offshore units, and
 - III. High-voltage electrical equipment (generators, transformers, etc.).

7.5 Important definitions

- **Control device:** Mechanisms used to control a machine function.
- **Effectiveness:** Compliance with technical standards to ensure the proposed risk reduction. Examples include safety distances, performance levels, integrity of structures, etc.
- **Hazard:** A potential source of injury or damage.
- **HRN:** Hazard Rating Number used to estimate a risk.
- **Interchangeable equipment:** A device other than a tool which, after being put into service in machinery, can be changed by operation/maintenance to a different function (e.g., exchanging an excavator shell for a stone crusher).
- **Machinery:** Machinery and equipment have several meanings:
 - An assembly, fitted with or intended to be fitted with a drive system other than directly applied human or animal effort (that is powered by energy sources), consisting of linked parts or components, at least one of which moves, and which are joined together for a specific application.
 - An assembly referred to in the first point that is missing only the components to connect it on site or to sources of energy and motion.
 - An assembly referred to in the first and second points that is ready to be installed and able to function as it stands only if mounted on a means of transport, or installed in a building or a structure.
 - Assemblies of machinery referred to in the first, second and third points, or partly completed machinery (see definition below), which, in order to achieve the same end, are arranged and controlled so that they function as a whole, integral machine.
 - An assembly of linked parts or components, at least one of which moves, and which are joined together, intended for lifting loads (e.g., a manual hoist) and whose only power source is directly applied human effort.
- **Maintenance:** All activities to repair and keep assets in good order, including planned predictive, preventative, corrective maintenance, problem solving and failure repair.
- **OEM:** Original Equipment Manufacturer.
- **Operation:** All activities performed during the normal operation of our work, such as production, set-up, changeover, and cleaning.
- **Partly completed machinery:** An assembly which is almost fully functional, but which cannot in itself perform a specific application. It is only intended to be incorporated into or assembled with other machinery or other partly completed machinery or equipment.
- **PL:** Performance level.
- **PLr:** Required performance level.
- **PPE:** Personal protective equipment.
- **Risk:** A combination of the possibility for and the degree of injury or damage.
- **MT:** The mission time duration in which a security component can be used. This represents the reliability of a component with respect to its safety performance.

7.6 Requirements for installation and equipment

7.6.1 General requirements

NOTE 1: Details of the requirements of this CAR are available in PGS-004951 – Machine Guarding Manual, which describes the best implementation and safety practices.

- a) Machines and safeguards must comply with technical standards and local legislation. Machine Guards must have project developed by a qualified professional.
- b) Machinery must be designed and constructed in such a way that prevents people being exposed to a hazard in any level. To avoid or reduce exposure to the hazard, the criteria in this table must be met:

Exposure level to hazard	1	2	3	4	5
Task characteristics	Work outside safeguards	Work through safeguards	Work inside the machine, behind safeguards	Work near hazardous energy/movements	No safeguards, everything is off
Task	Normal operation		Clearing jams / Tool change, etc.	Set-up, adjustment, process monitoring, etc.	Maintenance
Safety measures	Fixed guards or perimeter fencing	Protective devices	Key exchange / trapped-key interlock, multiple reset, tag system, partial lockout/tagout, etc.	Partial lockout/tagout / alternative measures	Lockout, tagout and zero energy (CAR 04)

- c) Hazardous energy-isolating devices (CAR 04) must be installed in an easily accessible location with sufficient space in which workers can stand when switching them on and off, allowing them to be locked out in the off position.
- d) All operating panels and components that require regular service must be located outside safeguards.
- e) All systems, components and devices used to perform a safety function (e.g., an interlocked protection interconnected to the safety relay that disables the operation of a motor) must be certified for use as a safety system by the manufacturer or by a recognized testing body.
- f) Where there is a risk of projecting or liquid or solid falling materials that could reach people, suitable guards must be installed to prevent accidents.
- g) The control systems of machines (e.g., start buttons, mode selectors, gate interlock systems connected to the machine safety stop interface, emergency stop systems, etc.) must be designed and constructed in such a way as to prevent the occurrence of hazardous situations. Control systems are detailed in item 7.1 of the PGS-004951 – Machine Guarding Manual, with special attention to:
 - I. Prevention of unexpected start-up of machinery,
 - II. Prevention of uncontrolled changes,
 - III. Priority over other controls,
 - IV. Visibility of the operation, etc.
- h) The control devices of machines (e.g., start buttons, mode selectors, gate switch systems interconnected to the machine stop safety interface, emergency stop systems, etc.) must be designed and constructed in such a way as to prevent the occurrence of hazardous situations. Control systems are detailed in item 7.2 of the PGS-004951 – Machine Guarding Manual, with special attention to:
 - I. Operation in an accessible way,
 - II. Safe position,

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- III. Clarity of functions and positions,
- IV. Audible and visual signaling (start-up, anomaly, overload),
- V. Commands and selection modes activated by voluntary actions, etc.

i) Fixed guards (fences, shields, covers, mesh, etc.), moveable guards (interlocked gates, guards fitted with interlocking devices) and protective devices (light curtains, scanners, etc.) used to prevent access to hazardous parts, movements and areas of the machine are detailed in item 7.6 of PGS-004951 – Machine Guarding Manual.

j) Guards must be selected according to the table below:

Frequency of access	Guarding type	Fixing	Interlock device required
Never	Fixed guards	Bolted / welded	No
Annual	Fixed guards	Bolted	No
Weekly	Fixed or moveable guards	Bolted (if fixed)	Yes (if moveable)
Daily	Moveable guards	N/A	Yes
Hourly	Moveable guards	N/A	Yes
More than hourly	Protective device	N/A	No

k) Guards in general must:

- I. Feature suitable construction and materials for their intended use and environment, and
- II. Adequately accommodate the frequency of access.

l) Fixed guards must:

- I. Only be opened or removed with use of a tool,
- II. Feature easy and safe handling for maintenance purposes, and
- III. Observe safety distances to prevent hazardous zones from being reached over, through and under.

m) Moveable guards must:

- I. Ensure interlocking, initiating machine stop when the guard is opened,
- II. Feature design and construction that allow them to be opened without a tool, and
- III. Stay closed and locked until the risk of injury from the hazardous machinery functions has ceased, included the inertia movement.

n) Protective devices must:

- I. Ensure detection of people in dangerous areas,
- II. Prevent unexpected start-ups when people are in the hazard zone,
- III. Generate a stop command when the hazard zone is infringed, which must be sufficiently quick to prevent access to hazard zones,
- IV. Must, where it is possible for a person to reach the hazard zone before the dangerous movements stop (e.g., due to inertia), be installed with a guard-locking device, in accordance with item 7.6.4 of PGS-004951 – Machine Guarding Manual.

NOTE 2: For safety distance measurement, refer to the tables available in item 7.8 of PGS-004951 – Machine Guarding Manual.

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- o) Machine fluid systems must:
 - I. Be equipped with protective and restraining systems by suitable means (adequate hose support, air fuses, shielding, etc.) to avoid whiplash caused by hose or pipe failures, and
 - II. Have a performance level (PL), according to item 7.11 of PGS-004951 – Machine Guarding Manual.
- p) Machines must be equipped with 1 (one) or more emergency stop devices to allow them to stop in an emergency, removing the power from the machine actuators in the best possible conditions, according to item 7.10 of PGS-004951 – Machine Guarding Manual.
- q) Safety control systems (e.g., interlocking connected to safety relays and actuators) must perform specified functions to achieve or maintain a safety machine/process state when unacceptable or dangerous process conditions are detected, according to guidelines in item 7.11 of the PGS-004951 – Machine Guarding Manual.
- r) Safety control systems must allow for the achievement of performance levels (PL) in accordance with the risk related to the safety function.
- s) The required performance levels (PLR) of the safety functions must comply with the table below:

Inherent risk level,	PLR	Min. safety category
Low	c	1
Medium	d	3
High	d	3
Very high	e	4

NOTE 3: ISO 13849-1 – Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design may alternatively be followed to determine the PLR.

- t) All energy sources must be designed and installed so that they do not endanger the safety or health of persons working on or nearby the machine, in accordance with the guidelines of item 7.12 of PGS-004951 – Machine Guarding Manual.
- u) Machinery must be provided with measures to prevent unexpected start-ups that can either be applied automatically (e.g., via a control system) or manually (e.g., via the control of hazardous energies), in accordance with item 7.13 of PGS-004951 – Machine Guarding Manual.
- v) Warning devices (preferably audible or visual) must be provided whenever the presence of persons in hazard zones of machines is difficult to notice. Such warning systems must alert personnel about the impending machine start-up, according to item 7.3 of PGS-004951 – Machine Guarding Manual.
- w) Warning signs (markings, pictograms, standardized colours, and written text in a local official language) must be used to indicate residual risks remaining in the machine, according to item 7.15 of PGS-004951 – Machine Guarding Manual.
- x) Machines and installations must be provided with safe means of access (for operation, adjustment, maintenance, cleaning, etc.), designed and built in accordance with item 7.14 of the PGS-004951 – Machine Guarding Manual.

NOTE 4: Means of access to the machines must be protected with a guardrail where there is a risk of falling (into the machine, or around the machine) over a height over 500 mm = 0.5 meters = 19.68in.

NOTE 5: Whenever the local legislation / standards are more restrictive with regards to means of access to machines, the local legislation / standards must be adopted.

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NOTE 6: Guardrails on escape routes must comply with the guidelines of PNR-000127 – Facility Layout – Escape Routes.

7.7 Requirements for procedure:

7.7.1 General requirements

NOTE 7: Details of the requirements of this CAR are available in the PGS-004951 – Machine Guarding Manual, which describes the best implementation and safety practices.

- a) Each location must have an inventory of its own machines and those of contracted companies.
- b) Each location must be provided with an inspection or maintenance plan (for Vale's own machines) and/or an inspection or maintenance procedure (for machines from contracted companies) for verifying the effectiveness and reliability (TM – Time mission) of the machines' protective systems and safety components, in accordance with the information from the manufacturer or most restrictive plan at Vale's discretion. The plan must include at least:
 - I. Fixed guards – fences, shields, mesh guards, fastening, etc.,
 - II. Moveable guards – interlocked gates, fastening, logics, etc.,
 - III. Automatic protective devices – presence sensors, light curtains, interlocks, controllers, actuators, etc., and
 - IV. Emergency stop devices – pushbuttons, ropes, etc.
- c) Activities that involve the removal of machine guards require a Safe Work Permit (PNR-000031 SWP).
- d) Machine guards that are removed must be put back in place before the machine is returned to operation.
- e) Safety devices that are removed or damaged and cannot be repaired and/or replaced during routine maintenance must be managed through the change management process (PNR-0000101). Contingency safety measures must be taken until the problem is permanently resolved. The permanent solution must be re-established as soon as possible, regardless of the production processes and documented in the HRN risk assessment.

7.7.2 Risk assessment (HRN methodology)

- a) A risk assessment must be carried out using the HRN methodology, on all new and existing machines, including those owned by contracted companies within Vale, with information on the risk reduction methods applied and recommended risk reduction measures.
- b) The result of the risk assessments must be expressed as per the table below:

HRN	MACHINE RISK LEVEL	TOLERABILITY
> 500	Very high risk	Mandatory risk level reduction
> 50 up to 500	High risk	Continuous monitoring
> 5 up to 50	Medium risk	Tolerable
0 up to 5	Low risk	Acceptable

NOTE 8: The risk levels classified above must follow the governance strategy out of Table 5 of the standard NOR-0003-G – Risk Management.

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- a) After the risk reduction measures are implemented, the risk assessment must be updated, keeping the initial risk assessment for reference.
- b) The risk assessment of machines in operation must be reviewed after operational changes or design modifications are made or an accident occurs (e.g., changes in operating parameters, newly introduced risks, changes in risk estimation parameters), in accordance with PNR-0000101 – Management of Changes.

7.7.3 Procedure for acceptance of new machines

- a) New machines must only be accepted upon presentation of a risk assessment report following the HRN methodology and indication of the achieved PL (Performance Levels) of each safety function of the machine.
- b) The manufacturer/supplier must provide a list of functional tests, focusing on safety aspects (e.g., static and dynamic mechanical stress analysis, safety control system performance levels, electrical equipment safety, ground continuity, noise levels, etc.).
- c) Specific verification, validation and acceptance tests of safety systems and safeguards must be carried out for each machine, including lockout of hazardous energy (e.g., isolation of hazardous energy – CAR 04, guards, emergency stop devices, enabling devices, etc.).
- d) The manufacturer / supplier must provide a machine safety layout containing at least the points indicated in item 6.f of the PGS-004951 – Machine Guarding Manual.
- e) The manufacturer / supplier must provide all certificates required by the legislation of the country or region where the machine will be installed.
- f) The manufacturer / supplier must provide all documentation indicated in item 6.h of PGS-004951 – Machine Guarding Manual.
- g) The manufacturer / supplier must provide the list of PPE required to perform each task on the machine, including machine usage signs and notices.

7.8 Requirements for training:

- a) Employees that work in operation, maintenance, adjustments, and other activities on machines must be trained on this CAR.
- b) Machine risk assessment specialists must be trained on the HRN methodology.
- c) Employees working on projects and machine acquisition must be trained on the requirements of this CAR.

7.9 Roles and responsibilities

7.9.1 Executive officers or managers

- a) Must formally assign persons responsible for carrying out risk assessments of new, existing and modified machines.
- b) Must formally assign one or more persons responsible for:
 - I. Creating and managing local procedures as described in this CAR,
 - II. Creating and managing local training programs,

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III. Creating and managing a program to verify the effectiveness of implementing the requirements described in this document, and

IV. Providing and managing the necessary resources to implement this CAR.

7.9.2 Managers:

- a) Must approve local procedures as described in this CAR.

7.9.3 Employees and contractors involved in machinery activities:

- a) Must comply with the requirements established in this document and in local procedures, and
- b) Must activate the local help chain, in case any identified irregularity cannot be resolved.

CAR 08: ACTIVITIES ON THE GROUND

8.1 Foreword

In past years, Vale's operations have experienced significant ground failures related to the instability of slopes, underground openings, and uncontrolled water flows. Some important contributing factors associated with these events have been:

- a) Geometry incompatible with design.
- b) Increase of saturation level (presence of water).
- c) Inappropriate execution of the activity.
- d) Use of inappropriate equipment type and/or size.
- e) Lack and/or failure of the support/shoring system.
- f) Lack and/or failure of protective barriers.
- g) Lack and/or failure of area isolation.
- h) Compromised or limited visibility.
- i) Operator fatigue.
- j) Failure in perceiving risks.

8.2 Purpose

The objective of CAR 08 is to establish minimum requirements that allow work near or on slopes as well as within underground openings to be carried out safely. The requirements of this CAR must be adhered to during the various phases of an asset's life cycle, from planning to construction, operation, and closure (and, when applicable, post-closure).

8.3 Application

The requirements of CAR 08 apply to all business units and operations managed by Vale, including new acquisitions.

8.4 Exceptions

The requirements of CAR 08 do not apply to excavations under 1,25 m.²⁷ and do not apply to the management of confined spaces.

²⁷ However, for excavations below 1.25 m, check whether there are buried structures in the area before the activity is carried out.

8.5 Important definitions

- **Asset:** A Vale-managed site that could be an exploration target, capital project, active operation, under care and maintenance, or under post closure management.
- **Asset life cycle:** The components of the life cycle of an asset include: 1) the conception and planning phase, 2) the design phase, 3) the initial construction phase, 4) the operations and construction phase in progress, 5) the temporary interruption of operations, and 6) the closure and post closure phases.
- **Checklist:** A verification list that must be completed prior to work which relates to risk identification, including a Safe Work Permit, Task Risk Assessment, or equivalent normative document.
- **Design:** The method, construction sequence/stages, and geometry of an asset to ensure a safe, efficient and effective excavation. **Mine plan** and **work instruction** are also synonymous with this term.
- **Emergency plan:** A set of actions and measures to be adopted in case of an adverse situation (i.e., an accident, incident, natural disaster, etc.), aiming to protect lives and assets, as well as to reduce the consequences of such a situation.
- **Excavation:** Removing soil or rock following design guidelines or another type of record or formal plan.
- **Experienced Individual:** An individual who is appropriately trained to complete the activity in question.
- **Failure:** Any unplanned movement of soil or rock that has a detrimental impact on the business.
- **Qualified individual:** A person who:
 - Has a degree in mine engineering, geology, or a related earth science, specializing in geotechnics and/or civil engineering.
 - Has an appropriate professional registration, when applicable.
 - Is a Senior Geotechnical Practitioner (or a rank above this) of Vale or an external consultant/contractor who has a working knowledge of the operation of interest.
 - A Qualified Individual must be specified in management plans and must have experience gained at an underground or surface mining operation, ground engineering company or geotechnical consultancy providing engineered underground designs, engineered slope designs, or hazard assessment services.
- **Secured ground:** Ground that has been scaled and/or reinforced to prevent failures that could result in injuries to personnel.
- **Slope:** Any inclined surface made up of soil or rock. It may be:
 - Natural: formed by nature with no human interference.
 - Engineered: slope that underwent human interference through cuts or fills:
 - Cut: An inclined surface resulting from excavation activities including roads and mining slopes).
 - Fill: An inclined surface resulting from material fill/stacking activities.
- **Trigger action response plan (TARP):** Defined thresholds that, when exceeded, trigger specific actions to mitigate risks

8.6 Requirements for installations and equipments

8.6.1 General requirements for tools, equipment, and devices

- a) Tools used for manual excavation must be appropriate for the activity to be performed, in good working condition, and used as per the relevant safe work procedure for the activity.

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- b) The type and size of equipment for excavation activities must be appropriate for the type of activity to be carried out, in good working condition, used as per the relevant safe work procedure for the activity, and able to reduce the risks to an operator to as low as reasonably practical.
- c) Maintenance of equipment used for excavation activities must be carried out in accordance with the manufacturer's recommendations.
- d) Lighting must be sufficient to allow work to be carried out safely and in accordance with the relevant safe work procedure.
- e) In cases where dust prevents the safe execution of an activity, additional actions must be carried out or devices installed and maintained to minimize dust and enable appropriate environmental and visibility conditions which allow work to be carried out safely and in accordance with the relevant safe work procedure.
- f) Devices necessary to manage surface water and groundwater must be implemented and maintained according to designs.

8.6.2 General requirements for barricades, signage, and protection barriers

- a) Access to an isolated area that has experienced a ground failure should be controlled as per the relevant safe work procedure, and should only be granted to people and equipment directly involved in remediation or repair work.
- b) Area isolation with barricades or physical barriers (protection barriers) and signage must be used. It is forbidden to use plastic striped tape to isolate an area.
- c) The type, size and location of protection barriers must be installed according to designs and commensurate with the potential hazard to ensure any ground failure is contained.
- d) The types of barricades²⁸ and signage used to isolate hazards must be stipulated in safe work procedures and must be in line with local legislation and Vale standards.

8.7 Requirements for Procedures

8.7.1 General requirements for monitoring

- a) A process for performance monitoring and inspection must be developed and implemented via safe work procedures. The process must define:
 - I. Instrumentation requirements, including the type, number, calibration needs, and maintenance routines.
 - II. Frequency and responsibility for inspection, monitoring and evaluation.
 - III. Guarantee and quality control requirements for support elements, excavation development, sequencing, and mining rate.
 - IV. Response actions regarding scenarios when specified limits have been exceeded.
 - V. Signage and restrictive actions for all geotechnical risk areas.
- b) An alert and communication system associated with slope and/or underground opening behavior monitoring must be in place as per a design and a Trigger Action Response Plan (TARP) must be in place.
- c) If ground failure is identified, work must stop and an assessment by an experienced or Qualified Individual must be completed, as defined in local procedure requirements. Resumption of work in the area can only occur once specified controls have been implemented.
- d) A conformance measurement process must be developed and implemented for slopes and underground openings. The results of such a process must be communicated to all those directly involved in the activity.
- e) The performance and conformance data of slopes and underground openings must be routinely reconciled with the design, which must be updated as required.

²⁸ The following types of barricades are considered: trestles, cones, chains. Barricades alone can not be used as barriers for protection purposes.

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- f) A safe work procedure (including re-entry protocol) and Trigger Action Response Plan (TARP) must be in place for seismicity.
- g) Duly experienced individuals must be appointed to carry out performance and conformance measurements.
- h) All geotechnical data must be stored in an accessible and auditable database.
- i) A work area inspection, which includes the completion of a hazard checklist, must be completed by an experienced individual directly involved in the activity prior to commencing work. This checklist must have fields to assist with the identification of geotechnical hazards. In situations where there is evidence of ground failure, the activity must be stopped, people and equipment should move to a safe location, and the person in charge/supervisor must be called. If in doubt regarding the measures to block/mitigate the risk, the person in charge/supervisor must inform the geotechnical team. A geotechnical engineer must complete an assessment of the area and define controls to be implemented before work can commence. The use of remote-controlled equipment must be considered to reduce the risk to acceptable levels. The definition of observations which prevent work from commencing must be made clear in the checklist. Work area hazard checklists must be stored in a readily accessible location according to a safe work procedure, so they are promptly available for later consultation.

8.7.2 General requirements for management plans, change management and emergency planning:

- a) Each asset must develop a management plan which is reviewed and approved by a Qualified Individual, as determined by local legislation, local procedures, risk assessment or a significant geotechnical incident. This plan must have:
 - I. Actions and accountabilities for managing slope and underground opening geotechnical risks, including effective communication and verification of geotechnical risk management strategies.
 - II. Actions and accountabilities to set design and executive methodology specifications.
 - III. Engineered slopes and underground openings must be based on adequate geological, geotechnical and hydrogeological data.
 - IV. Plans and accountabilities must be determined governing the way engineered slopes and underground openings are designed and constructed.
 - V. Plans and accountabilities must be determined governing the way natural slopes and underground openings are assessed and managed.
 - VI. Standards and accountabilities must be determined governing the way an Experienced or Qualified Individual must assess and validate mine designs so as to guide the team towards actions that must be implemented to mitigate geotechnical risks.
 - VII. Standards and accountabilities must be determined governing the way engineered slope and underground opening designs must meet, or exceed, specified minimum design acceptance criteria using industry accepted design techniques.
 - VIII. Standards and accountabilities must be determined governing the way experienced individuals directly involved in an activity, or their supervisors, must check work area information with regards to the main risks already mapped, the history of previous ground failures, and uncontrolled water flows.
 - IX. Standards and accountabilities must be determined governing the way an experienced or Qualified Individual must be responsible for natural slope and underground opening geotechnical hazard management strategies as well as engineered slope and underground opening designs.
 - X. A safe work procedure must be in place and adhered to governing the detonation of explosives and the re-entry of areas where explosives have been detonated.
 - XI. Standards and accountabilities must be determined governing the way all forms of ground failure will be investigated, addressed and recorded.
 - XII. Work area information must be provided with regard to the main risks already mapped, the history of previous ground failures, and uncontrolled water flows will be checked.
 - XIII. If geotechnical conditions encountered in the field are significantly different than assumptions used for designs, standards and accountabilities must be determined governing the way the geotechnical team will

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be notified to assess if designs need to change and their responsibilities to document and notify relevant personnel of changes to existing ground conditions and controls.

- b) Management plans for specific geotechnical material unwanted events such as rockburst, inundation of liquids, in-rush of solids, or airblast should be developed if local legislation demands, or if deemed necessary by a risk assessment.
- c) A change management process must be implemented and used in case of major changes and documented in a procedure. This procedure must also specify clearly what constitutes a major change to designs and geometries.
- d) Slopes and underground openings that may pose a hazard must have an emergency plan, which must include the use of an effective communication system that is tested according to a defined frequency specified in a procedure.
- e) Clear and visible signs must be in place which demarcate egress routes and muster points in case of an emergency. These routes and muster points must be visible on plans accessible to personnel.

8.7.3 Surface activities requirements:

8.7.3.1 Requirements prior to the beginning of the activity:

- a) For civil earthworks, there must be a check completed for buried utilities. The person in charge of the activity must consult the relevant drawings related to buried utilities in the area. In case of possible interference with a utility, a specific assessment of the area must be carried out using suitable equipment. A report on the assessment must be written and part of a checklist for identification of risks and controls.
- b) Phreatic level drawdown targets as defined in designs must be adhered to.
- c) Physical slope design markers in the field must be clear and in compliance with designs; alternatively, accredited CAD tools that have been tested can be used on equipment.
- d) All mining fronts must have physical slope design markers in place to ensure slopes are implemented according to designs.
- e) Excavations to a depth of 1.25 meters or more must be designed by a Qualified Individual, and have support, shoring system, or protection barrier in place or sloping/benching carried out, as well as a means of egress. Excavation work can only commence once the support, shoring system, and/or protection barrier is in place.

8.7.3.2 Requirements to execute the activity

- a) Actions are forbidden which involve the deliberate removal of slope support, and/or form steep or negative slopes out of alignment with designs.
- b) Actions are forbidden which involve the deliberate placement of low-strength materials, and/or potentially unstable blocks out of alignment with designs, as well as compaction of material outside design specifications.
- c) Deployment of mine and waste disposal plans must comply with safe work procedures and technical instructions.

8.7.4 Underground specific activities

8.7.4.1 Requirements prior to the beginning of the activity

- a) Ground support designs must consider failure mechanisms, the purpose of the support, its service life, and opening geometries and induced loads it must address over its service life.

8.7.4.2 Requirements to carry out the activity

- a) No personnel must work beneath ground, or at a face, that has been inadequately secured.
- b) Safe work procedures must be developed and adhered to which specify:
 - I. The persons authorized to install ground support in accordance with approved designs and the training required to prepare them.
 - II. The tools and equipment required to install monitor and inspect ground support, which cater to all sizes of excavation encountered in the mine.

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- III. The tools and equipment required for scaling that cater to all sizes of excavation encountered in the mine and which will allow loose material to be removed without exposing persons performing the work to injury.
- IV. The persons authorized to scale and the training required to prepare them.
- V. All lateral and vertical development methodologies, including perimeter control.
- VI. Breakthrough of lateral and vertical development.

8.8 Requirements for training

Employees who carry out activities close to or on slopes and/or within underground openings must be:

- a) Trained in CAR 08 local and global training, including its updates, according to Vale's Qualification Guidelines.

8.9 Roles and responsibilities

The responsibility to follow and enforce these requirements is inherent to all employees of Vale's units who perform activities related to the management of slopes and underground openings, including contractors and supervisors.

See below a description of the relevant roles and responsibilities:

8.9.1 Executive management (Geotechnics, Operation, and Infrastructure):

- a) To be qualified in the global CAR 08 training.
- b) To provide resources (financial, team, logistics, equipment, etc.) to guarantee the appropriate execution of activities.

8.9.2 Area management must be:

- a) Qualified in the global CAR 08 training.
- b) Responsible for making sure that controls are effectively implemented in the area under its responsibility.
- c) Be responsible for technical support and monitoring compliance and application of controls defined.

8.9.3 Health, Safety & Environment (HSE) professionals must be:

- a) Qualified in RAC 08 (global and local training).
- b) Responsible for technical support and monitoring compliance and application of controls defined.

8.9.4 The person in charge of the activity / supervisor²⁵ must:

- a) Be qualified in RAC 08 (global and local training).
- b) Be responsible for following up and checking the quality of the way the risk assessment process is carried out regarding activities that will be executed.
- c) Ensure changes regarding activity status between shifts, technical and operational teams are communicated.
- d) Check eventual anomalies reported or registered, using a checklist.
- e) Ensure implementation and ensure compliance with relevant Critical Activity Requirements.
- f) Ensure those involved in carrying out critical activities are qualified.
- g) Ensure there is flow management regarding activities to assess risk perception and follow up activities on slopes.
- h) Interrupt or suspend any activity that does not comply with the requirements of this CAR and/or that may compromise the objective of preserving physical integrity.

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8.9.5 The person in charge of the activity / supervisor²⁹ must:

- a) Be qualified in RAC 08 (global and local training).
- b) When applicable, develop the checklist prior to beginning activities.
- c) Be responsible for making sure that controls defined are effectively implemented in the area under their responsibility.
- d) Attach the interference assessment report, when applicable.
- e) Isolate the work area and lock out hazardous power sources, when applicable.
- f) Ensure that only appropriate equipment and tools are used.
- g) Interrupt or suspend any activity that fails to meet requirements in this CAR and/or that may compromise the objective of preserving physical integrity.

8.9.4 Professionals directly involved must:

- a) Be qualified in RAC 08 (global and local training).
- b) When applicable, develop the checklist prior to beginning activities.
- c) Be responsible for making sure that controls defined are effectively implemented in the area under their responsibility.
- d) Attach the interference assessment report, when applicable.
- e) Isolate the work area and lock out hazardous power sources, when applicable.
- f) Ensure that only appropriate equipment and tools are used.
- g) Interrupt or suspend any activity that fails to meet requirements in this CAR and/or that may compromise the objective of preserving physical integrity.

²⁹ Those who can be assigned as responsible for the activity are a contract inspector and/or a third-party agent.

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9. CAR-09 – EXPLOSIVES:

9.1 Foreword

Some of the critical accidents at Vale have occurred during explosives handling and transport. The main contributing factors associated with these incidents were:

- a) Inadequate handling and transport of explosives and accessories causing impacts and activation,
- b) Exposure of the explosives to heat,
- c) Exposure of the explosives to atmospheric and electrical energy,
- d) Lack of knowledge about the products,
- e) Inadequate isolation system in the area before blasting,
- f) Proximity of the worker to sources of ignition and blasting,
- g) Inadequate storage of explosives,
- h) Activation of explosives by static energy, and
- i) Failure in the execution of the blast plan.

9.2 Purpose

To set the minimum requirements for critical activities related to transporting, storing, manufacturing, handling, charging, and blasting explosives, including safe practices and distancing.

9.3 Application

Critical activities related to transporting, storing, manufacturing, handling, loading and blasting explosives in open pit and underground mines and construction projects (to open roads and tunnels and remove obstacles).

9.4 Exceptions

CAR 09 does not cover handling of explosives related to demolition of structures (buildings, bridges), and external transport of explosives by third parties.

9.5 Important definitions

- **ANFO** – Ammonium nitrate fuel oil.
- **Airblast**: An airborne shock wave resulting from the detonation of explosives.
- **Blasting influence area**: The area where the effects of the blasting can be felt or cause damage by vibration, airblast, fly rock, fumes, and dust.
- **Blaster**: The person responsible for handling explosives and accessories, who is responsible for organizing, distributing, and connecting the initiation system, isolating the area, and supervising the rock blasting.
- **Blasting exclusion zone (area isolation)**: The area determined by a risk assessment process in which to assure that all expected / foreseen effects of the blasting are kept within a controlled area. The blasting exclusion zone can be subdivided into subzones, with an inner sector defined as an equipment exclusion area and a wider area defined as a people exclusion area.
- **Bench face**: Exposed surface of the rock where the mining work is progressing.

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- **Collar:** The opening of a borehole where the explosives will be loaded.
- **Competent person:** An experienced professional duly certified to handle explosives.
- **Deck:** Material placed in the borehole to separate explosive charges, such as an intermediate stem, made of inert material (such as gravel) or an air bag, used for the blasting control.
- **Electronic detonator:** A device formed by a fuse coupled to an electronic circuit that allows delays to be programmed (activation timed). It is activated by a set of programming and detonation equipment specific for this purpose.
- **Environmental emergency kit:** A set of materials necessary to contain and remove spills involving emulsion and ANFO.
- **Fly rock:** A condition in which a rock fragment is propelled beyond defined limits of the blasting safety area.
- **Free face:** The face of the bench without rock from the previous blasting.
- **Hangfire:** Burning explosives pursuant to a misfire of any kind. It usually results from an interruption in the explosives column caused by debris and drilling dust or loose material in the hole, which create separations, offsets or compressions of the hole due to the rock movement or other factors that decrease or interrupt the steady state speed of the explosive charge. Hangfire might result in explosion, especially if the burning explosive is confined in the blast hole.
- **Misfire:** A charge, or part of an explosive charge, which for some reason did not blast as planned.
- **Magazine:** A building intended to store explosives and their accessories, ammunition or other controlled products. It can be permanent or temporary.
- **MSDS:** Material Safety Data Sheets.
- **MMU:** Mobile manufacturing unit. This is a truck developed to carry out multiple mixtures to produce ANFO, or heavy ANFO, and an emulsion and to pump or dump these products by means of a screw conveyor directly into the holes in rock blasting operations.
- **MPU:** Mobile pumping unit. This is a truck developed to transport and apply oxidizing emulsion and gasification additive.
- **Open flame:** A mixture of incandescent gases which emit energy, also called open flame, flame or fire.
- **Overbreak:** Fractured/broken rock that travels beyond the planned extent of the rock blasting.
- **PAE:** Acronym for emergency response plan in Portuguese.
- **Small diameter:** A hole of a diameter equal to or smaller than 4 inches.
- **Primer:** A set of explosives, basically composed of a booster and a detonator or explosive sensitive to the detonator and a detonator used to start the main column charged with emulsion or ANFO.
- **Stemming:** Inert material used to confine gasses generated during explosives detonation.

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9.6 Requirements for installations equipment

- a) The explosives storage and preparation areas must comply with the provisions in the local legislation, based on a formal project prepared by a competent professional.
- b) To assure the minimum requirements necessary for safety while transporting, storing and handling accessories, explosives, matrix emulsion and ammonium nitrate, these guidelines must be followed:
 - I. PNR-000015 – Fire Protection and Fire Fighting System (SPCI) – General
 - II. PNR-000022 – Handling of Hazardous Products - Explosives - Factory
 - III. PNR-000031 – Guidelines for Safe Work Permit
 - IV. PNR-000052 – Electrical Systems – General – SPDA
 - V. PNR-000060 – Handling of Hazardous Products – Explosives – Application and Removal of Charge
 - VI. PNR-000066 – Emergency Response Management
 - VII. PNR-000101 – Management of Change (MoC)
 - VIII. PNR-000124 – Handling of Hazardous Products – Explosives – Storage
 - IX. PNR-000132 – Pre-Departure Safety Review
- c) The tools and accessories used in the activities covered in this CAR must be anti-spark.
- d) The storage and handling instructions for each product stated in the respective MSDS must be followed (incompatibility of materials, static energy, temperature, etc.)
- e) There must be informative and warning signs in the internal and external areas of the magazine (prohibition to use cell phones, metal tools, lighters, matches, etc.).
- f) Permanent or temporary explosive storage areas must be locked and segregated from other vulnerable areas (electrical and mechanical installations, evacuation areas, fuel storage areas, etc.).
- g) Vehicles for transporting explosives and accessories must be used exclusively for this purpose, must comply with local legislation and the requirements of CARs 02 and 03, and must be provided with:
 - I. Static energy dissipation devices,
 - II. Specific signaling,
 - III. Flame arresting device in discharge pipes (underground mine and open pit). For open pit mines, discharge pipe outlets positioned upwards can be applied in place of the flame arrester.
- h) The blasting system must comply with the specifications below:
 - I. **Open-pit mines** must use an electronic fuse in 100% of the blast plan, in the development and production phases. If identifies the need to use 2 (two) detonators per hole, the second detonator must be electronic or conventional (non-electric), according with the local risk analysis.
 - II. **Underground mines** must use an electronic fuse in 100% of the blast plan in the production phase. If identifies the need to use 2 (two) detonators per hole, the second detonator must be electronic or conventional (non-electric), according with the local risk analysis. In the development phase or mining methodology chambers and pillars, the activation must be remote and may use a non-electric system.
 - III. The electronic fuse must have extra protection against electromagnetic pulse, and proof by the manufacturer through a certificate.

NOTE 1: If allowed by local legislation, pre-splitting can be performed using a detonating cord, with electronic initiation.

NOTE 2: It is forbidden to use a cap fuse (conventional) as an explosive charge initiator.

- i) An anti-static protection device must be guaranteed at the entrance of the magazine, according to the manufacturer's guidelines contained in the Material Safety Data Sheets (MSDS).

9.7 Requirements for procedures

9.7.1 General requirements procedures:

- a) The safety guidelines of the explosives and accessory manufacturers stated in the MSDS must be followed.
- b) It is forbidden to handle explosives and accessories on surface before and during storms when the possibility and/or occurrence of electrical discharge (lightning strike) exists.
- c) To perform hot work near the explosives storage areas (deposit and factory), the following must be applied PNR-000031 Safe Work Permit (SWP) Guidelines
- d) It is prohibited to smoke, use an open flame, and carry lighters, tools or material that may produce sparks in places where explosives are stored or handled.
- e) It is prohibited to use electronic devices that are not intrinsically safe in places where explosives are stored or handled and that are classified as a restricted or flammable area.
- f) It must be ensured that information and blasting schedules reach those involved (internal and external).
- g) It must be assured that information about and notice and rescheduling of blasting times will reach all people involved, internally and externally.
- h) Excess explosives and accessories must be returned to the magazine.
- i) Explosives that are in an impaired state of conservation, defective, or non-conforming, including explosives from misfire, must be identified, segregated and destroyed, according to regulations in force and manufacturer's instructions, PNR-000124 – Magazine – Handling of Dangerous Products – Explosives – Magazine and PGS-00004640 – Handling and recovery of holes with electronic detonator failure.

9.7.2 Storage procedures:

- a) Explosives and accessories must be kept in their original packaging.
- b) In the deposits, the explosives and the accessories must comply with the material compatibility group according to the MSDS and PNR-000124 – Magazine Handling of Dangerous Products – Explosives – Magazine.
- c) It must be applied an inventory for the control of storage of explosives and accessories in magazines.

9.7.3 Procedures for transporting accessories and explosives in vehicles:

- a) In the loading and unloading activity, explosives and accessories must be placed directly on the transport vehicles positioned in previously marked locations.
- b) The vehicles must be grounded while explosives and accessories are being loaded and unloaded.
- c) Transshipping explosives and accessories to other vehicles outside the magazine is forbidden, except in emergency (vehicle breakdown, sticking, rain, etc.).
- d) If accessories and explosives are transported simultaneously, a (shielded) compartmentalized boxes must be used to prevent contact between the accessories and explosives.

Note 3: If Vale needs to carry out external transport of explosives, comply with PNR-000124 – Magazine Handling of Dangerous Products – Explosives – Magazine and local legislation.

9.7.4 Blasting handling and preparation:

9.7.4.1 General requirements:

- a) In the area to be blasted, signaling must be applied at the entrance of the mine with boards containing the blaster's (the person responsible for the blasting) radio band and telephone number, blasting times and locations.
- b) The person responsible for the activities must assure that all people have been evacuated from the area and the vicinity that can be affected before releasing the area for blasting.
- c) An audible alarm system must be activated before detonation, according to PNR-000060.

9.7.4.2 Open-pit mines:

- a) A georeferenced system must be used (GPS, maps, etc.) to encircle these areas.
- b) The explosives loading area must be blocked, respecting the safety distance defined in risk analysis and local procedure. Where technology is available, perform electronic blocking of autonomous mobile equipment (trucks, etc.).
- c) A physical block must be carried out in the detonation influence area. Where technology is available, perform electronic blocking of autonomous mobile equipment (trucks, etc.).
- d) The fire plan should establish measures to protect people and nearby communities, including distance and protective barriers.

9.7.4.3 Underground mines:

- a) The explosives loading area must be blocked, respecting the safety distance defined in risk analysis and local procedures.
- b) To carry out the detonation, personnel must be evacuated from the detonation influence area (where there may be gases, dust, material projections, or seismic vibration that may affect the stability of the landform).
- c) An effective process to control the entry and exit of the area of influence of the detonation (where there may be gases, dust, material projections, or seismic vibration that affects the stability of the land form) must be available (example: the use of label frames).

9.7.5 Blast plan:

9.7.5.1 Content for blast plan:

A blast plan and an executed blast plan must be established, including at least:

- a) Fire Plan objectives - Type of blasting;
- b) identification of the fire plan (polygon, date, time, blaster and signature of the technician in charge);
- c) excavation area, rock volume;
- d) characterization of the material to be disassembled;
- e) diameter(s) of hole(s);
- f) bench height;
- g) determination of the perforation mesh (type of mesh, distance, spacing, number of lines);

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- h) depth and depth of holes, average, minimum and maximum depth;
- i) number of holes, perforated footage, extra holes;
- j) under-drilling;
- k) buffer determination;
 - I. depth;
 - II. type;
 - III. plugs;
- l) use of decks (type, if you are going to use it);
- m) explosives (types) and properties (density);
- n) total explosive charge (kg);
- o) accessories.
- p) load ratio (specific load) kg / m³ and / or kg / t;
- q) timing (layout and movement of the rock mass);
- r) pre-splitting.
- s) relief line;
- t) distance to the nearest structure to be protected.
- u) estimation of particle velocity (peak) and acoustic pressure.
- v) rock projection estimate.
- w) calculation of SDoB (dimensioned burial depth) - energy control scale.
- x) radius of the safety zone (plan with definition of the safety zone for people and machines);
- y) layout (plan) of the drilling grid.
- z) hole profiles (terms) with primer positioning, loads, decks and buffer.

9.7.5.2 Requirements to return after blasting:

Return to the blasting site must occur only after the fumes and dust have dissipated and misfire has been verified and authorized by the person responsible for the activities as below:

- a) Open pit and underground mines: The minimum time for return after blasting must be established.
- a) Underground mines: The minimum time for return after blasting and atmospheric monitoring must be established.

9.7.6 Misfire:

- a) In case of suspicion or finding of a misfire, the PGS-00004640 – Handling and recovery of holes with failure in the electronic detonator must be complied with.
- b) In case of a failed fire initiation, wait at least 30 minutes before to take any action, in addition to checking the characteristics of each location.
- c) If a misfire in the muckpile is detected or suspected after the blasting area is released, the work must be stopped immediately, the area must be evacuated, and the situation must be reported to the person responsible for the activities who will adopt the appropriate measures to control the risk.

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9.8 Requirements for training:

- a) The employees who carry out activities for manufacturing, transporting, storing, handling, charging, and blasting explosives must be trained in this CAR.
- b) The specialists in manufacturing, handling, and blasting explosives (e.g., the Blaster) must be trained in accordance with local legislation.
- c) The qualification guideline in PNR-000069 CAR must be met.

9.9 Roles and responsibilities

9.9.1 Division or executive managers:

- a) Formally designate one or more people to be responsible for developing and maintaining the following processes/procedures/controls:

- I. A policy of following local procedures as described in this CAR,
- II. A training and evaluation program for employees involved in the process of manufacturing, transporting, storing, handling, charging and blasting explosives,
- III. A program for verifying the effectiveness of implementing the requirements described in this document,
- IV. A process to provide the necessary resources for implementing this CAR.

9.9.2 Management:

- a) Approve local procedures as described in this CAR, and
- b) Formally approve the employees authorized to carry out activities with explosives and accessories.

9.9.3 Employees and contractors involved in activities with explosives and accessories must:

- a) Comply with the requirements set forth in this document and local procedures, and
- b) Call the local help chain if any identified irregularity cannot be resolved.

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10. CAR-10 – WORKING WITH ELECTRICITY:

10.1 Foreword

Several serious and/or potentially serious events took place in the last 10 years, involving the exposure of people to electrical hazards. The main factors associated to these events were:

- a) Work within the Electrical Shock Hazard Distance and/or within the Electrical Arc Flash Hazard Distance without the appropriate barriers/ protections;
- b) Lack or deficiency in systems, devices or identification of electrical protection;
- c) Lack or deficiency in Personal Protective Equipment;
- d) Lack or deficiency in the proven voltage absence test;
- e) Lack or deficiency in the identification of equipment/components;
- f) Lack or deficiency of technical documentation (single line diagrams, project specifications, etc.);
- g) Lack of criteria to select measuring instruments to perform electrical tests;
- h) Use of inadequate tools/ equipment;
- i) Lack or deficiency of procedures to perform electrical work;
- j) Not complying with procedures to perform electrical work;
- k) Lack or deficiency of training of people performing electrical work activities;
- l) Lack or deficiency of professional qualification of the personnel who perform the electrical work activities;
- m) Failure to lockout electrical energy (CAR04 – Lockout, Tagout and Zero Energy);
- n) Failure to correctly apply the clearance distance for the circulation of mobile /lifting equipment near overhead energized electrical lines (CAR01 – Elevated Work, CAR03 – Mobile Equipment Operations and CAR05 – Lifting of Loads);
- o) Lack or deficiency of protection barriers to avoid the contact of metallic structures with energized surfaces;
- p) Failure or deficiency in the protective measures that prevent the re-energization of lines, equipment and components after an automatic trip.

10.2 Purpose

To establish Safety and Health requirements to eliminate, control or mitigate the hazards of fatalities, injuries or incidents involving electrical work

10.3 Application

All works in electrical installations containing equipment/systems with voltages above 50 V AC (Alternating Current) or 120 V DC (Direct Current).

The requirements in this CAR apply to the following works, but are not limited to the examples below:

- a) Preventive or Corrective maintenance or electrical switching in electrical switchgear, connection and lighting panels, automation panels, switchgear and distribution panels, junction boxes, Cubicles and Cabinets, frequency Inverters and generators;
- b) Tests in industrial outlets;
- c) Sensitive and predictive inspections in panels or equipment in the field;
- d) Preventative maintenance in rectifiers, chargers and battery banks;

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- e) Preventative or corrective maintenance in Plug and Switch System (PASS) control circuits;
- f) Preventative or corrective maintenance in control circuits of oil or dry transformers;
- g) Opening and Closing disconnecting switches.

10.4 Exceptions

The requirements in this CAR do not apply to the following works:

- a) Manual positioning of excavator electrical power cables (CAR 03 – Operation of Mobile Equipment);
- b) Maintenance and use of electric power driven tools (drillers, sanders, saws, chainsaws, grinders, etc.);
- c) Maintenance of laboratory equipment (chromatographs, analyzers, ovens, etc.);
- d) Maintenance in office machinery (computers, copying machines, TV sets, vending machines, etc.);
- e) Work near electrical equipment or installations, such as: installation of telephone or data wiring, grass and tree cutting activities, cleaning and housekeeping inside electrical rooms and substations, etc.;
- f) Operation or circulation of mobile/lifting equipment near overhead energized electrical lines (CAR's 01, 03 and 05);
- g) Excavation work on the proximity of underground electrical lines;
- h) Work performed by the local power distribution company.

10.5 Important Definitions

ATPV, Arc Flash, Working Distance, Incident Energy, Arc Flash Boundary, Label, Electrical Arc Flash Hazard Distance, Electrical Shock Hazard Distance – definitions are available at PNR-000051.

Damp location – locations protected from weather and not subject to saturation with water and other liquids but subject to moderate degrees of moisture.

De-energized Electrical Work - Work performed on an equipment or component that is part of the electrical system which is disconnected from any source that may generate a difference in potential and electrical charge, with no potential difference in relation to the grounding system.

Diagnostic work – work that does not require any physical change to the equipment/component, such as readings, measurements, and tests.

Electric Power Systems – Set of installations and equipment aimed to generate, transmit and distribute electrical power including the measurement device.

Electrical equipment and installations – sets of equipment and components described in the objective and application of PNR-000053 – Electrical Systems – General.

Electrical Switching – manual or automatic change in the electrical settings or a circuit, by means of an adequate device designed for this purpose.

Energized Electrical Work - Work performed on an equipment or component that is part of the electrical system which is connected to any source that may generate a potential difference or electrical charge.

Energized part – energized conductive equipment.

High Voltage, Low Voltage, single line diagram (item 6.4.1 – Operation – Item i) – definitions are available at PNR-000053.

Hazardous classified areas – definition is available at PNR-000027.

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Live line work or Hotline maintenance: work performed in a voltage source or in an equipment or component that is part of the electrical system which is electrically connected to a voltage source, where there is intentional contact of the professional with the energized parts of the equipment or electrical system components with the hands, feet or other part of the body, with tools, probes or test equipment regardless of the PPE that the worker is using.

Personal Protection Safety Barriers – means used between the energy source and the worker to prevent the contact with electrical energy in case it is released and/or to interrupt its flow when it is released. Examples of safety barriers for electrical energy include arc flash and electrical shock PPEs, blankets and matting for electrical shock protection, among others.

Repair work – work that requires physical alteration of the equipment/component, such as tightening connections, cleaning, removing, or replacing components.

Temporary Electrical Grounding – definition is available at PGS-004901.

Wet location – installations underground or in concrete slabs or masonry in direct contact with the earth or locations subject to saturation with water or other liquids. Installations and locations not protected from weather.

10.6 Requirements for installations and equipment

The electrical equipment and installations must have, as a minimum:

- a) Identification of incident energy as per requirements of PNR-000051 – Incident Energy, for the equipment included at Table 2 of the document.
- b) Grounding/Lightning Protection as per requirements of PNR-000052.
- c) General Protection Systems for Electrical Systems as per requirements of PNR-000080.
- d) Electrical diagrams and supporting documentation as per requirements of PNR-000053.
- e) Residual Current Devices (RCD) or Ground Fault Protection or similar as per critical analysis defining the application of such devices, based on the hazards of electrocution, on the local legislation and technical standards and on the project specifications.
- f) Appropriate protection that prevents inadvertent contact with energized parts.
- g) Safety signs complying with the local legislation.

10.7 Requirements for procedures

10.7.1 General Procedures

- a) The electrical work where the worker enters the Electrical Arc Flash Hazard Distance or where there is interaction of the worker with equipment, conductors or parts of circuits, with the probability of injuries to the worker due to electrical arc flash or electrical shock must adopt the electric de-energization by means of the following steps, except in the situations covered in item 10.7.3:
 - I. isolating;
 - II. lockout (impediment to re-energize);
 - III. test of absence of voltage at the intervention point;
 - IV. temporary grounding installation with equipotentialization of the circuit conductors at the intervention point;
 - V. protection of the energized parts present at the Electrical Arc Flash Hazard Distance Zone, when applicable;
 - VI. installation of signs of impediment to re-energize.

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- b) It is prohibited to perform live line work or hotline maintenance in high voltage (above 1kV), including works in power transmission lines with energized circuits.
- c) It is prohibited to perform any electrical work on high voltage power circuits, including cleaning, which requires entry into cubicles compartments, without the complete de-energization of all inlet and outlet points of the panel that could result in electrocution and/or exposure the workers to incident energy levels capable of causing burns and/or more serious consequences.
- d) The workers must be authorized to perform electrical work as per local legislation. The authorization must be documented in the work contract records of the company.
- e) It is prohibited to perform any electrical work without specific formal authorization for the activity.
- f) The electrical works must have a Safe Work Permit as per PNR-000031.
- g) It is prohibited to perform high voltage energized electrical work individually.
- h) Local criteria must be defined to establish the situations which require that low voltage energized electrical work must not be performed individually.
- i) Studies of incident energy must be prepared and implemented for electrical equipment as established in PNR-000051.
- j) The work on energized panels with incident energy above 40 cal/cm² is prohibited as established in PNR-000051.
- k) The Personal Protective Equipment must be defined in local procedures and compatible with the voltage and incident energy levels of the electrical installation, with the use of PPE with minimum value of 10 cal/cm², being mandatory, as per PNR-000051.
- l) For works inside the Electrical Arc Flash Hazard Distance (EAFHD) a personal voltage detector type “helmet” or “wrist” (or similar device) compatible with the involved voltages must be used as an individual protective measure to alert against a non intentional proximity of parts of the body to energized surfaces.
- m) The Personal Protective Equipment – PPE, the equipment, instruments, and tools to be used in electrical work must be inspected before each use.
- n) The use of personal ornaments (watches, rings, earrings, necklaces, among others) is prohibited while performing electrical work.
- o) The Personal Protective Equipment and the collective protections used as barriers (examples: rubber gloves, blankets, matting, temporary grounding systems, etc.) and the tools used in high voltage electrical work must be periodically tested complying with the manufacturers’ instructions and local legislation, and the maximum interval between the tests must not exceed 12 (twelve) months. The tests results must be properly recorded.
- p) The measuring equipment / test meters used to perform electrical work must be inspected, calibrated and tested complying with the manufacturers’ instructions and local legislation, and the maximum interval between tests must not exceed 24 (twenty-four) months. The tests results must be properly recorded.
- q) The reset of electrical devices after an automatic trip must comply with local criteria which include the definition of personnel authorized to reset the device, as well as the confirmation that there is no failure in the system and/or exposure of other workers to the associated hazards.
- r) Criteria must be established to authorize the access to distribution panels and substation.
- s) In high voltage panels, the temperature measurement in busbars and connections must be performed without opening the panel doors complying with the requirements of PNR-000131. In low voltage panels, the temperature measurement in busbars and connections must be performed in such a way that the workers do not exceed the working distance as defined in the incident energy study and in a specific procedure in accordance with item 10.7.3 of this document.
- t) The use of metallic ladders in electrical work is prohibited.

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- u) The use of metallic scaffolding and other equipment made of conductive metal where they may come into contact with an energized surface is prohibited.

10.7.2 Procedures for de-energized electrical work

The local procedures to perform de-energized electrical work must be approved by a qualified professional and must contemplate as a minimum:

- a) The scope of the job;
- b) The identification of the equipment included in the scope of the job;
- c) The identification and control/isolation measures for all parts and/or circuits which remain energized and exposed around the work area;
- d) The job functions authorized to perform the job;
- e) Training required to perform the job;
- f) Requirements for electrical energy lockout as per requirements of CAR 04;
- g) Requirements for voltage absence tests;
- h) Tools/ equipment/ test meters compatible with the involved voltages;
- i) Personal Protective Equipment compatible with the voltage levels and incident energy;
- j) Steps, specific hazards and control measures to perform the job, also considering the Hazard Management Plan developed in compliance with PNR-000051 when applicable;
- k) Additional control measures if the electrical work takes place in hazardous classified areas, wet/damp areas, underground areas, confined spaces or restricted areas.

10.7.3 Procedures for energized electrical work

The local procedures to perform energized electrical work must be approved by a qualified professional and must contemplate as a minimum:

- a) The job scope;
- b) Identification of the equipment contemplated in the scope of the job;
- c) Area Manager Approval, based on a job risk analysis, testifying that the de-energization of the equipment or installation introduces additional or increased hazards or is unfeasible due to the equipment design or limitations of the equipment or type of job to be performed;
- d) The identification and control measures of all parts and/or circuits which remain energized and exposed around the work area;
- e) The job functions authorized to perform the job;
- f) Training required to perform the job;
- g) Number of people who will perform the job;
- h) The requirements for continuous communication during the execution of energized electrical work;

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- i) Collective protective measures that must be installed (physical barriers, lockout of electrical energy, temporary grounding, etc.);
- j) Personal Protective Equipment compatible with the voltage levels and incident energy;
- k) Tools/ equipment/ test meters compatible with the involved voltages;
- l) Steps, specific hazards and control measures to perform the job, also considering the Hazard Management Plan developed in compliance with PNR-000051 when applicable;
- m) Additional control measures if the electrical work takes place in hazardous classified areas, wet/damp areas, underground areas, confined spaces or restricted areas.

10.7.4 Electrical Switching Procedures

The local procedures to perform electrical switching must be approved by a qualified professional and must contemplate, as a minimum:

- a) The description of the switching;
- b) The identification of equipment which will be switched;
- c) The Job Functions authorized to perform the switching;
- d) Training required to perform the job;
- e) Number of people who will perform the switching;
- f) The requirements for communication during the execution of the switching;
- g) The on-off switching and the insertion and extraction of circuit-breakers and contactors in electrical panels must be done remotely with the worker(s) not exceeding the safe approaching distances when the panels are not resistant to internal arc and the switching cannot be performed with the working and adjacent doors or drawers closed.
- h) Personal Protective Equipment compatible with the voltage levels and incident energy;
- i) Steps, specific hazards and control measures to perform the job also considering the Hazard Management Plan developed in compliance with PNR-000051 when applicable.

10.8 Requirements for training

- a) The workers who perform electrical work must be trained in Hazard Prevention in electrical works.
- b) The workers who perform activities in Electrical Power Systems must have specific training according to local legislation.
- c) The workers who perform electrical work in hazardous classified areas according to PNR000027 must have specific training.

10.9 Roles and responsibilities

10.9.1 Directors or Executive Area Managers:

- a) Assign one or more people responsible to:

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- I. Develop and maintain local procedures as described in sections 10.7.1, 10.7.2. 10.7.3 and 10.7.4 in this CAR;
- II. Develop and maintain training programs and evaluation of employees who perform electrical work, as described in sections 10.7.1 and 10.8 of this CAR;
- III. Develop a program to check the effectiveness of implementation of the requirements of this CAR;
- IV. Guarantee the necessary resources to comply with the requirements of this CAR.

10.9.2 Executive Managers:

- a) Designate the qualified professionals who must approve the local general procedures, the procedures for de-energized works, the procedures for energized works and the procedures for electrical switching.
- b) Formally approve the workers authorized to perform electrical work as per requirement 10.7.1.b of this CAR;
- c) Approve the Risk Management Plan in case the calculated incident energy of the equipment where work will be performed is above 8 cal/cm²;
- d) Approve energized electrical work based on Risk Job Analysis testifying that the de-energization of equipment, installation or machine introduces additional or increased hazards or is unfeasible due to the equipment design or limitations of the equipment or type of job to be performed.

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11 CAR-11 – MOLTEN METAL:

11.1 Foreword

Several serious and/or potentially serious events have occurred in the last 10 years, involving exposure of people to molten metal.

11.2 Purpose

To establish Health and Safety requirements to eliminate, control and minimize the risk of fatalities, injuries or incidents involving activities with molten metal.

11.3 Applicability

Activities involving molten metal, including but not limited to:

- Furnace;
- Converter ;
- Granulator;
- Transportation of molten metal (by heavy equipment and by crane);

11.4 Important definitions:

High Temperatures: temperature high enough to cause discomfort or even damage to the physical integrity of people and/or equipment.

11.5 Requirements for equipment and installation

11.5.1 General requirements:

- a) Fire Protection and Suppression of the Furnace must be designed according to specific PNR (PNR 000016- Protection and Fire Fighting System – Tanks- Flammable and Combustible Liquid).
- b) Water based extinguishers shall not be provided near the molten metal facility.
- c) Design of the building must consider escape/ emergency routes in case of the emergency situation.
- d) Building shall be designed with adequate floor drainage directing any water towards the side of the building, not allowing water accumulation.
- e) Lounder must be designed to prevent the potential effects of a spill or splash of molten metal or must have temporary containment means.
- f) Transfer lounder and molten material containment vessels must be designed in a way that provides a process for diversion of the material in the event of a possible spillage.
- g) The gas analyzer (e.g. CO and SO₂) must be installed around the building and audible and visual alarm must be activated when the presence of the gas is above the limit defined in local procedure.
- h) Exhaust ventilation must be provided around the building to reduce dust particle and presence of toxic gas at the critical areas.
- i) General Inspection program/ walkthrough must cover the presence of water on the building to avoid the risk of water contact with molten metal.
- j) When applicable, leak detection system must be installed in the cooling water system. The monitoring system must be sensitive enough to indicate water leakage however small it is, avoiding its contact with molten metal.

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- k) A roof integrity program shall be executed to ensure roof integrity to prevent rain water going into the building.
- l) Where applicable, temperature sensor/ transmitter shall be installed in the converter and furnace shell/ end wall refractory to enable early detection of hot spot (refractory failure).
- m) Equipment used in molten metal activities must have an emergency stop, where applicable.
- n) An emergency cooling water supply must be available in case of main cooling system failure. It must be also independent of power supply in case of power outage.
- o) Intake and other feeding systems must be designed or automated in such a way as to keep people at a safe distance from charging points.
- p) Furnaces and converters must have a monitoring and control system to reduce gases that can be generated during the process, such as CO, CO₂, NO_x, hydrogen or others.
- q) The monitoring rooms must be endorsed with concrete protections resistant to impacts and to high temperatures.
- r) It must be applied the online thermal monitoring for the convertor.
- s) Where applicable, a level sensor/ indicator must be adopted to avoid overloading of molten metal into the convertor.
- t) A monitoring level system must be applied to avoid overcharging of molten metal into the furnaces and to define the position of slag and matted inside the furnace.

11.5.2 PPE's and tools:

- a) Personal and collective protection equipment (e.g. aluminized suite, gloves, hood, boots, etc.) must be purchased from registered manufacturers, in accordance with existing standards, approved and certified by the competent authorities. The protective equipment must be maintained and used in accordance with standard established by manufacturers.
- b) Splashing shield must be installed to protect the worker from molten metal splash during the execution of tasks with risks of splashing.
- c) The sampling tools must have adequate length to allow the sampling operator to perform the task from a safe distance.
- d) When applicable, the personal gas detector (pocket detector) can be applied.
- e) Workers who are working directly with molten metal or within the range of molten metal exposure must wear protective clothing (aluminized suite).
- f) Employees working with molten metal must wear special protective goggles to visualize the baths of molten materials, avoiding visual fatigue or potential vision damage.
- g) Tools applied for removal of slag, drilling, and leakage of molten metal must be free of rust and moisture before to use.
- h) Other employees who are working or visiting molten metal area (but not working directly with molten metal) must wear fire retardant clothes.

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11.5.3 Requirements for transportation and molten metal transfer equipment

- a) Where applicable, hot metal transfer equipment must contain location/ positioning sensors connected to the tilting sensor of the equipment in order to ensure that the unloading of the molten metal is in the correct location.
- b) Transfer routes of molten metal by road (haul master or other heavy equipment) must be well defined to minimize the risk of spillage during the road transport.
- c) Overhead crane must be equipped with visual and audible alerts that indicating that molten metal transport and hot metal crane maneuver is taking place.
- d) When applicable, hot metal cranes must have anti-collision sensors/ proximity alert to prevent collision among cranes.
- e) Vehicle cabs, where practicable, which has potential exposure to splashing, explosion, or projection of molten metal must be protected with appropriate material (protective barriers).
- f) Surfaces of equipment that come into contact with molten metal must be coated in such a way as to prevent exothermic reactions or leakage
- g) Transfer equipment must be designed to withstand exposure to high temperatures.

11.5.4 Gas treatment and cooling:

- a) When applicable, gas washing and treatment systems must be provided with instrumentation to monitor:
 - I. Composition of the generated gas (to monitor the percentage of H₂, CO, CO₂ and O₂ and provide adequate alarms /interlocks).
 - II. Gas flow and temperature.
 - III. Gas washer water level alarm.
 - IV. Interlocking for excessive fan vibration.
 - V. Temperature of the filter sleeves.
 - VI. Pressure monitoring.

11.5.6 Sinaling and warning:

- a) Molten metal processing sites must have unique audible alarms that operate above ambient noise, which can be heard to warn the personnel in case of uncontrolled molten metal leakage or adverse reactions occur.
- b) Warning plates must be durable in the environment in which they will be used, standardized and easy to view.
- c) There must be a "Warning plate" with clear and permanent information informing the prohibition of the traffic of unauthorized persons in the areas handling matte, slag and other hot metal with proper size.

11.6 Requirements for procedure

11.6.1 General requirements:

- a) Flammable and combustible products storage must be kept away from the working areas with molten metals.
- b) Molten metal safety zones must be defined and documented as part of operational procedures.
- c) Preventive maintenance programs must be established for all critical equipment used in molten metal process.
- d) Preheating must be conducted if necessary to ensure no remaining water/ moisture inside the equipment that contain molten metal (e.g. ladles, pots, tundish).
- e) When applicable, visual level monitoring by operator must be adopted to avoid overcharging of molten metals in equipment

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- f) Communication and signaling systems must be applied consistently to reduce the risk of exposure to people working in the operations of molten metal.
- g) The materials must be stored in a way that prevents contamination by moisture that may react with a molten metal bath.
- h) Closed containers of insums are prohibited from being added directly to the molten metal due to the potential risk of explosion.

11.6.2 Emergency and rescue:

- a) Emergency and Rescue Service must be in place to protect the workers handling molten metal, for which it must:
 - I. Include in the emergency scenario involving molten metal.
 - II. Training and drill of the brigade team for emergency care and response involving molten metal related incident.
- b) The emergency preparedness and plan must be developed which include communication of an event, effective escape routes provision, and evacuation plan for people exposed to direct or indirect contact with hot materials, also for situations of spontaneous leakage, equipment stoppage, and isolation of the area in emergency situations.
- c) When the furnace is loaded, there must be no employees positioned in the roof of the furnace.
- d) Roof access control must be provided to avoid access to furnace roof when furnace is energized

11.6.3 Requirements for transportation and liquid metal transfer equipment

- a) Transfer equipment requires a traffic plan that includes routes and control over transfer speed.
- b) Proper method such as road isolation shall also be provided when the road is also used by other vehicles.
- c) Lifting movement of molten metal by the use of remote control can only occur:
 - I. If the control site removes the individual from the imminent exposure for handling of molten metal and the associated risks.
 - II. If the visual field of the area can be maintained at all times during the transfer process.

11.6.4 Requirements for inspection and monitoring:

- a) Periodic inspection and, when applicable, pre-use inspection of molten metal transport and handling equipment, tools and accessories must be applied.
- b) An inspection program must be established to routinely evaluate the mechanical integrity of the equipment (furnace, granulator, convertor, etc.) associated with the molten metal process to prevent equipment from further shell deformation.
- c) Operational process control parameters must be continuously monitored
- d) inspection program must be established for gas exhaust systems associated with molten metal operations before they are put into service.
- e) Processes must be established for routine monitoring of instrumented controls and visual inspection around the cooling water system to ensure that leaks do not go unnoticed.
- f) Process monitoring alarm devices must be routinely monitored to identify operational parameters approaching or exceeding boundaries.

ANEXX I - Internal Traffic Plan

The traffic plan must include at least the following basic elements:

- a) Purpose:
 - I. Purpose of the internal traffic plan.
- b) Responsibilities:
 - I. Describe the responsibilities under the internal traffic plan.
- c) Traffic Rules - Describe local rules from/to:
 - I. Traffic (general) and circulation, including overtaking;
 - II. Speed limits, considering adverse weather conditions;
 - III. Safety distances and restricted areas (exclusion zones);
 - IV. Parking lots (position, distance, etc.);
 - V. Approaching mobile equipment or mobile equipment areas;
 - VI. Access of Truck/cargo, use of spotters/observers Traffic of special cargo (chemicals, explosives, liquid metals);
 - VII. Emergency situations (e.g. collision, rollover, fire, explosion, projection of materials, crushing and running over) and towing;
 - VIII. Abnormal situations in motor vehicles and mobile equipment;
 - IX. Interaction between vehicles and equipment, including guidelines on the use of communication devices;
 - X. Communication between pedestrians, vehicles and equipment;
 - XI. Road block;
 - XII. Priority to the right between vehicle/equipment and pedestrian types;
 - XIII. Instructions on drilling, disassembly and disassembly siege areas, where applicable.
- d) Parking Areas:
 - I. Describe the parking areas by vehicle type and parking position;
- e) Roads - Describe the process for defining and reviewing roadways (design, layout, directions, slopes, surface, traffic control). The roads must be defined to:
 - I. Maximize the segregation of vehicles/equipment from other objects, including pedestrians, buildings, sidewalks, safe paths and other vehicles/equipment;
 - II. Consider paths and/or routes in case of emergencies;
 - III. For the transport of liquid metals, consider the possibility of exclusive internal roads and request the approval of traffic agencies for circulation on public roads.
- f) Pedestrian Safety and Internal Road Control Measures:
 - I. Describe the process for defining and maintaining pedestrian safety and internal road control measures (vehicle types, traffic, distances, guardrails, insulation barriers, sidewalks, among others);
- g) Lighting:
 - I. Describe the process for defining and maintaining the traffic lighting and operation roads;
- h) Signs:
 - I. Describe the process for defining and maintaining traffic signs (speed limits, directions, permissions and prohibitions, parking areas, crosswalks, intersections or roundabouts, level crossing, among others).

ANNEX II – RAC 05

Minimum Criteria for a Rigging Plan

The Rigging Plan must include the following technical information:

- a) General:
 - I. Company Name, place of work, work area, workpiece to be lifted / moved, workpiece weight;
 - II. Calculation memory, device designs, demonstrative drawings of all lifting phases, the most critical positions and expected clearances in relation to interference.
- b) Operational detailing:
 - I. Crane Identification: make, model, rated capacity and Series, outriggers area;
 - II. Crane configuration: boom, crane capacity, workpiece net weight, attachment weight and block, operating radius, gross load weight, cable runs (number of cable legs), counterweights, shoe positioning, JIB length, JIB angle and etc;
 - III. Crane Utilization Percentage: Classification as a percentage of crane utilization in the operation in question;
 - IV. Crane gross capacity: according to load table values and crane lifting diagram, safety factor, load factor.
- c) Lifting:
 - I. Determine lifting accessories, wire rope loops (units), cable capacity, shackles, shackle capacity, type of lashing, other materials, capacity of other materials, lashing design.
- d) Rolling and positioning:
 - I. Shoe force / maximum load on the paddle, padding material (metal or wood), padding area, required minimum ground strength, padding detail and positioning (drawings);
- e) Additional safety information related to load lifting:
 - I. Maximum allowable wind speed for crane.
- f) Site / area visit data (where applicable):
 - I. Date of the technical visit, name of the person responsible for the technical visit, name of the person providing the information, date of preparation, name of the developer, date of revision, name of the controller.
- g) Drawings:
 - I. Complete layout of the operation with top, side, perspective, interference (electrical networks, equipment, installations, roads, access, gutters, culverts, ditches, pipelines, etc.) and their respective dimensions with technical drawing made by hand or through specific software.
- h) Approvals:
 - I. Signature of own or contracted rigger, area / customer signature, reviewer rigger signature, where applicable and date.

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ANNEX III - Deadlines specified by requirement and treatment for non-compliance with CAR requirements

1 - Deadline for CAR requirements:

1.1 -Requirements that have had the extended deadlines (Annex IV):

For requirements that, due to the need for adaptations or acquisition of equipment and installations, had an extension of deadline, interim measures were defined (Annex IV) for the execution of the activity without the requirement until the expiration of the deadline.

1.1.1 - Non-compliance with the interim measures for requirements that had extended deadlines:

In case of non-compliance with the interim measures defined in the Annex IV, must follow the exceptional approval flow and adopt at least the conditions below in the period of 1 (one) month from the date of publication of this annex. In case of non-compliance with the interim measures and no implementation of the conditions below the activities must be stopped.

- a) Identification of all equipment and installations that do not comply with the interim measures/requirements;
- b) Development of an action plan to comply with the requirements/ interim measures;
- c) Definition of temporary control measures, which must be reflected in risk analyzes (JHA/JSA);
- d) Presentation of the items above for formal and documented approval by the Executive Manager of HSOR and Executive Manager of Operations/Construction.

1.2- Requirements that did not have extended deadlines:

1.2.1 - Procedural requirements (expired due date on 20/06/2020):

The area must have local procedures for critical activity in accordance with the PNR 000069.

The procedural requirements comply including requirements for critical activity in local procedures and training of the executors.

Critical activities that do not comply the procedural requirements after the date of publication of this annex must be stopped.

1.2.2 - Equipment and installation requirements (expired due date on 20/12/2020):

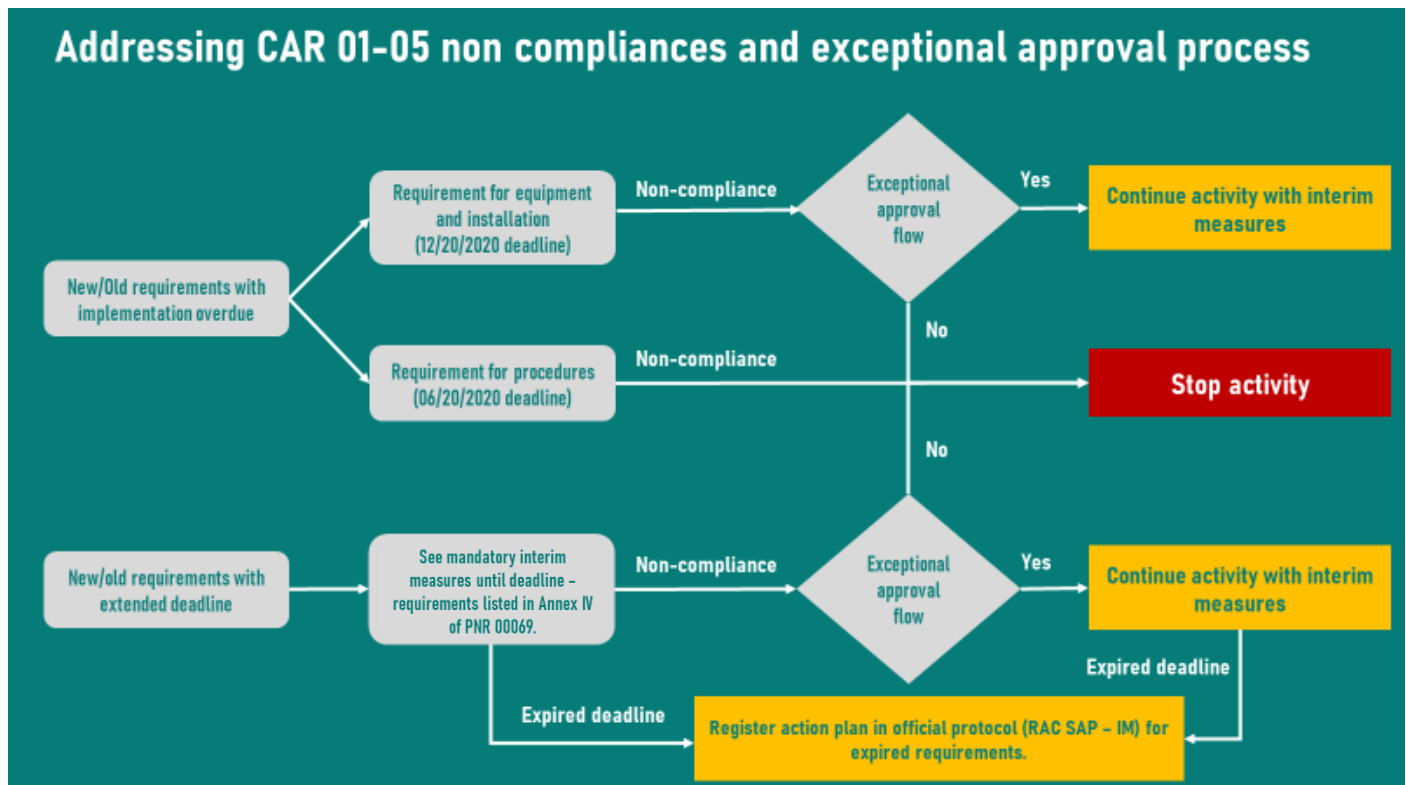
In case of non-compliance with the equipment and installation requirements that did not have the due date extended in the Annex IV, must follow the exceptional approval flow and adopt at least the conditions below:

- a) Identification of all equipment and installations that do not comply with the interim measures/requirements;
- b) Development of an action plan to comply with the requirements/ interim measures;
- c) Definition of temporary control measures, which must be reflected in risk analyzes (JHA/JSA);
- d) Presentation of the items above for formal and documented approval by the Executive Manager of HSOR and Executive Manager of Operations/Construction.

The items above must be completed in the period of 1 (one) month from the date of publication of this annex and are valid until 30/06/2021, that is the deadline for the implementation of the requirements. In case of non-compliance with the items above or of non-compliance with the requirements until the deadline, activities must be stopped.

1.3 – Non-compliance with the requirements of Annex IV with expired deadlines:

In case of non-compliance with the expired requirements of Annex IV, the executive management must register an action plan in the official protocol (CAR SAP – IM) for the expired requirements. The IDs of these protocols can be requested from the area by the 2^a Line of Defense at any time.



Exceptional approval flow

- Identification of all equipment and installations that do not comply with the interim measures/requirements;
- Development of an action plan to comply with the requirements/ interim measures;
- Definition of temporary control measures, which must be reflected in risk analyzes (JHA/JSA);
- Presentation of the items above for formal and documented approval by the Executive Manager of HSOR and Executive Manager of Operations/Construction.