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1. OBJECT
The object of the present Manual is to make known to workers carrying out their professional activity on OSSA sites the PREVENTIVE MEASURES that must be permanently observed while carrying out the work in order to avoid or minimise risks.
2. OCCUPATIONAL RISK PREVENTION OBJECTIVES AND POLICY
The aim of the policy is not only to provide the necessary means to assure the safety and health of OSSA’s human resources, but also to effectively improve the conditions in which they carry out their work, thereby raising the levels of wellbeing and satisfaction among the workers.

- These aims are based on the following guidelines:

  - Attain a high level of health and safety at work, complying with the currently effective legislation on Occupational Risk Prevention

  - Develop, implement and maintain a Prevention Management model aimed at ensuring continuous improvement of the working conditions, laying down the prevention organisational structure and defining the responsibilities, obligations, rights, procedures and resources required.

  - Promote a prevention culture that ensures real and effective compliance with prevention obligations rather than mere formal compliance.

  - Prevent work-related accidents, incidents and diseases, and enhance workers’ quality of life.

  - Promote the principle of prevention responsibility at all levels within the company.

  - Work towards making all OSSA infrastructure compliant with current prevention legislation, keeping a record of facilities subject to risks and drawing up procedure manuals for their operation.

  - Require our suppliers, concessionaires and subcontractors to comply with the Occupational Risk Prevention Act.

  - Promote the co-ordinated development of Prevention within the framework of international convergence.

In order to attain these objectives we need the cooperation and commitment of all the human resources in the company.
WORKERS’ RIGHTS AND OBLIGATIONS
3.1. WORKERS’ RIGHTS

- Effective occupational safety and health protection.
- To receive information on the general and specific risks relating to safety and health and work, the applicable protection and prevention measures and activities, and those adopted with regard to first aid, worker evacuation, etc.
- To receive classroom and practical training on prevention matters.
- Regular medical monitoring.
- To participate in and be consulted on all occupational safety and health related issues.
- To stop working in case of serious and imminent risk.
- Special protection for minors and maternity.
- Designation of Prevention Delegates.

For any questions regarding prevention issues and to facilitate worker participation you may contact the Prevention Delegates. Alternatively, proposals can be forwarded on an individual basis by writing to consultayparticipacion@ossaint.com.

3.2. WORKER’S OBLIGATIONS

- Make every effort to ensure their own safety and health and those of other people potentially affected by their professional activity.
- Make proper use of machines, devices, tools, hazardous substances, transport equipment and in general any other means used to carry out their activity.
- Make proper use of the protective means and equipment provided by the employer, adhering to the instructions received.
- Refrain from disabling the safety devices and features of the equipment and systems associated with their work station and activity.
- Immediately report to their immediate manager and to designated prevention officers any situation they deem on reasonable grounds to constitute a risk for worker health and safety.
- Contribute to ensuring compliance with the obligations established by the competent authority.
- Co-operate with their employer in ensuring safe working conditions.
SITE PREVENTION ORGANISATION
Accident prevention is the responsibility of all the individuals forming part of OSSA on every work site, as well as external subcontractors, self-employed professionals, etc… The following prevention organisation is in place to ensure proper execution of the work.
5. GENERAL SITE SAFETY RULES
BEFORE ACCESSING THE SITE, YOU SHOULD KNOW...

- It is the responsibility of each worker to look after their own safety and health at work, as well as those of all other individuals that could potentially be affected by their work, through compliance with the prevention measures that apply in each case.

- You must use the personal protective equipment required to visit the site or for the specific type of work you are going to perform.

- You must give priority to collective protection over personal protection measures.

- You must always follow the manager's instructions.

- Never remain alone or without reporting your presence in a given location.

- You must cooperate with your immediate manager in making the work conditions safe and avoiding risk to other workers.

ONCE ON THE SITE...

- Access to the site shall only be through designated entrance routes, always identifying oneself at the entrance checkpoint.

- All workers must be suitably identified at all times.

- Observe and adhere to the signposted site safety measures.

- You must use the pedestrian walkway or authorised areas when traversing the tunnel.

- Only use the equipment and machinery that you are qualified and trained to use.

- Keep clear of and do not invade the operating radius of machines.

- Do not stand under suspended loads

- Keep your work station clean and tidy.

- Immediately report to your managers any situation potentially involving a worker safety and health risk.

- In case of emergency, remain calm and follow the instructions of the response team or alternatively follow the signposted instructions.
IT IS FORBIDDEN TO...

■ Withdraw, tamper with or alter any signs or collective protection equipment.
■ Go near the edge of cuttings or stand below them.
■ Approach the operating radius of moving machinery, stand under suspended loads or touch any potentially live electrical parts.
■ Handle or tamper with any kind of machinery not under one’s responsibility.
■ Carry people in vehicles not designed for human transport.
■ Access the tunnel while debris removal is in progress.
■ Light a fire
■ Smoke inside the tunnel.
■ Take any alcoholic beverages, drugs or medicines that could alter the perception of risks at work.
■ Clean oneself using compressed air, oxygen or other pressurised gas.
■ Use mobile phones while driving.

IT IS MANDATORY TO...

■ Always use the mandatory PPE (hard hat, safety boots, impact protection glasses, ear protection and high visibility working clothes).
■ Use protective glasses on all work sites and all types of work or areas where they are required.
■ Observe all the site signals.
■ Keep one’s work station clean and tidy.
■ Use tools with their protective guards.
■ Work on electrical installations may only be carried out by duly authorised qualified personnel.
■ Avoid exceeding the speed limit within the site.
■ Use the safety belt when operating forklift trucks or self-propelled machinery.
■ Immediately report any incident, regardless of its severity.
All self-propelled machinery must have their light and sound warning devices in perfect conditions.

Use a double lanyard attached to a rigid anchor point for any work at height, on scaffolding or on elevating platforms.
6. TYPES OF PROTECTION (INDIVIDUAL & COLLECTIVE)
All personal protective equipment or collective protection elements shall have a specified service life, and shall be taken out of service once this has expired.

If, due to work conditions, a PPE is subject to faster than usual degradation, this will be replaced regardless of its specified service life or issue date.

6.1. COLLECTIVE PROTECTION

One of the basic principles of safety at work is to “give precedence to collective protection over personal protection”.

The collective protection elements most commonly used in the excavation of a tunnel are:

- Warning lights and sounds for reversing machinery.
- Perimeter lights on vehicles and machines
- Ventilation system
- Dust extraction system on the excavation face
- Gas detectors
- Communication links with the exterior
- Interior lighting
- Route and access point signalling lights
- Surveillance of all access points by workers and optical and/or acoustic signals
- Signposting of the working area by means of stakes or flags
- Signposting of the vehicle and worker transit routes
- Safety mesh signalling the excavation work area
- Separation of vehicle and pedestrian transit
6.2. PERSONAL PROTECTIVE EQUIPMENT (PPE)

The term Personal Protective Equipment (PPE) refers to any equipment, complement or accessory intended to protect the worker. It provides effective protection when it is not possible to install collective protection.

- They must be properly used to ensure their effectiveness
- They shall be stored in a suitable location after use
- They must be replaced when degraded or at the end of their specified service life.

**HEAD PROTECTION**

A hard hat provides protection against:

- Falling objects: tools, bricks, etc.
- Impacts against moving objects: machines, moving loads, etc.
- Impacts against fixed objects: piping, passage areas, etc.
- Flying objects: shards, tool fragments, etc.
- Electrical contact: cables, motors, etc.

**FOOT PROTECTION**

Protective footwear provides protection against:

- Falling objects (metal toecap): beams, pallets, etc.
- Impacts: pipes, rocks, etc.
- Stepping on pointed objects (safety insole): nails, etc.
- Electrical contact
- Rubber boots provide protection against:
- Water and damp: work in the rain, etc.
HAND PROTECTION

Gloves provide protection against:
- Cuts: reinforcement mesh, etc.
- Abrasions: rocks, etc.
- Chemicals: acids, solvents, lubricants, mortar, etc.
- Electrical contact: cables, motors, lights, etc.

EYE PROTECTION

Safety eyewear provides protection against:
- Flying particles: work with grinders, jackhammers, sparks, etc.
- Radiation: arc welding, oxy-fuel welding, etc.
- Chemicals: acid, solvent, etc. splashes.
- Dust: concrete, material cutting, etc.

EAR PROTECTION

Ear protection equipment provides protection against:
- Noise: work with jackhammers, cutting with saws and any other work with high noise levels.

**Earplugs must be properly fitted in the ears to ensure suitable protection.**
AIRWAY PROTECTION

Respiratory protection equipment provides protection against:

- Inhalation of gas, vapours, mist, smoke or dust.
- Suffocation caused by oxygen deficiency: access to confined spaces.

**Specific filters for contaminants shall be replaced when dirty or when no longer effective.**

SELF-CONTAINED BREATHING APPARATUS: SELF-RESCUE DEVICE

This personal protective equipment operates independently from the atmosphere by means of a two-way closed-circuit breathing system based on the principle of chemically bonded oxygen.

The oxygen required for breathing is obtained from a solid chemical substance (KO₂), which reacts with the CO₂ and water vapour present the air breathed out by the user. These two components of exhaled air are absorbed by the KO₂, releasing the chemically bonded oxygen.

These devices protect users in situations where the oxygen content in breathing air is insufficient or the concentration of toxic gases is too high. Its useful service life in the event of an emergency is approximately 30 minutes.
The use of a safety harness is mandatory for any work exposing the worker to falls from heights of more than 2 metres, such as:

- Installation and removal of collective protection devices (nets, guardrails, covering holes…).
- Installation and removal of scaffolding, elevating platforms, cranes, installations…
- Assembling metal structures.
- Work on roofs.
- Work near floor edges, excavations, unprotected openings …
- Prior to starting work the lanyard and karabiner must be inspected.
- Use a double lanyard attached to a fixed anchor point for any work at height, work on scaffolding or work from elevating platforms.

This will address impact risks (slipping, falls) and tripping risks

The anti-vibration belt and wrist straps provide protection against:

- Musculoskeletal injuries to the spine, lumbar region and wrists.
- This protection equipment must be used for work involving exposure to this type of risk, such as driving machinery, using jackhammers, vibrating rollers, tamping equipment, etc.
7. SAFETY SIGNPOSTING
WARNING SIGNS

FLAMMABLE MATERIALS
EXPLOSIVE MATERIALS
TOXIC MATERIALS
CORROSIVE MATERIALS

TRIPPING RISK
SUSPENDED LOADS
FALLS
ELECTRIC HAZARD

GENERAL HAZARD
LASER RADIATION
COMBURENT MATERIALS
NOXIOUS & IRRITANT MATERIALS

USE
Used to warn of the presence of a risk or hazard
PROHIBITION SIGNS

- NO SMOKING
- NO SMOKING OR LIGHTING FIRES
- NO PEDESTRIAN ENTRY
- DO NOT EXTINGUISH WITH WATER
- NON-DRINKABLE WATER
- NO UNAUTHORISED ENTRY
- NO ENTRY FOR LIFTING VEHICLES
- DO NOT TOUCH

USE

Used to prohibit behaviour likely to cause a hazard
MANDATORY SIGNS

- Eye Protection Mandatory
- Head Protection Mandatory
- Ear Protection Mandatory
- Airway Protection Mandatory
- Foot Protection Mandatory
- Hand Protection Mandatory
- Body Protection Mandatory
- Face Protection Mandatory
- Personal Fall Protection Mandatory
- Protection Mandatory for Pedestrians
- General Mandatory Observance

USE

Used to indicate mandatory requirement to follow a behaviour considered to be safe.
FIRE FIGHTING EQUIPMENT SIGNS

- FIRE HOSE
- LADDER
- EXTINGUISHER
- FIRE FIGHTING TELEPHONE

DIRECTION TO BE FOLLOWED

USE
Used to provide indications regarding fire extinguishing methods and equipment used in the event of a fire
RESSCUE OR EMERGENCY SIGNS

EMERGENCY ROUTE/EXIT

OVER 65 YEARS OPENING THE WAY UNDERGROUND

DIRECTION TO BE FOLLOWED

FIRST AID

STRETCHER

SAFETY SHOWER

EYE RINSE

USE

Used to provide information on emergency exits, first aid and rescue devices
8.1. TUNNEL EXCAVATION CYCLE

DRILLING

EXPLOSIVES PLACEMENT

BLASTING AND VENTILATION

SCALING AND DEBRIS CLEARING

HOLDING
A.- TUNNEL FACE DRILLING

The boreholes are drilled using hydraulic hammers fitted onto a self-propelled machine known as a jumbo. The hammer operation is based on a roto-percussion system, i.e., the drill is constantly rotating and at the same time impacting the bottom of the bore.

Hazard and Risk Identification:

- Flying particles.
- Exposure to noise.
- Trapping by rotating drills.
- Falls when climbing up or down from the equipment.
- Knocking and/or running over by moving equipment.
- Knocking and trapping between the jumbo’s arms.
- Exposure to dust.
- Detachment of material due to unstable ground.
Safety Rules – Preventive Measures

■ Seal off the work area by means of ribbons or cones.
■ Use ear protection and impact protection glasses.
■ Verify that nobody is in the vicinity of the machine before starting to work with it.
■ Do not stand within reach of the drilling arms.
■ Only expressly authorised operators shall be allowed to operate the machines.
■ Climbing up and down from the machine shall be performed facing the support fittings (handles and steps).
■ Drilling shall be performed by a wet drilling system or using dust capture devices.
■ It is every operator’s responsibility to carry out a daily inspection of the machine prior to starting work with it.
■ Only operate from the area that is properly supported; it is forbidden to enter the non-fortified area.

B.- EXPLOSIVES PLACEMENT

Following the blasting scheme designed upon commencing the work, on the basis of the rock type, the explosive charge is introduced into the bores drilled by the jumbo, in the order in which they will be detonated.

The explosives may be supplied in cartridges or in bulk as an emulsion. Once they have been placed in the bores, the detonators are connected to each other and the area is evacuated in order to verify and fire the blast.

Hazard and Risk Identification:

■ Falls between different levels.
■ Exposure to noxious substances.
■ Falling materials due to unstable ground.
■ Falls when climbing up to or down from the equipment.
■ Knocking and/or running over by moving equipment.
- Overexertion.
- Explosion when handling the detonating material.

**Safety Rules – Preventive Measures**

- Sealing off the work area by means of ribbons or cones.
- Only workers expressly authorised by the site manager and holding the appropriate blaster qualification card will be allowed to handle the explosive.
- Use of protective gloves and safety harness for work from an elevating platform.
- It is strictly forbidden to smoke or use tools generating hot surfaces.
- Work ladders shall be aluminium and shall be firmly resting against the face and on the ground.
- Wooden rammers will be used to avoid the risk of sparking during the placement of the explosives at the bottom of the boreholes.
- Electric detonators: during handling they must be short circuited and once the explosives placement is complete they shall be connected in series.
The primer cartridge shall be prepared immediately prior to the placement.

The materials required (explosives and detonators) shall be carried to the face separately.

**C.- BLASTING AND VENTILATION**

Prior to detonating the charges, all the power supply sources on the excavation face shall be disconnected, ventilation must be stopped and the electrical continuity of the circuit shall be verified using an ohmmeter.

Once all personnel have been evacuated from the tunnel, the explosive is fired from a safe position. Upon completing the detonation, the face ventilation system is reconnected to evacuate the smoke and gases generated by the blast.

**Hazard and Risk Identification:**

- Tripping.
- Exposure to smoke and gases generated by the blast.
- Falling materials due to unstable ground.

**Safety Rules – Preventive Measures**

**Prior to blasting:**

- Verify that the face where the blasting will take place has been evacuated.
- Prevent any access by personnel or equipment.
- Provide a sound warning that the blast is about to be fired by sounding a horn or other system.

**After the blast:**

- A waiting period of approximately 30 min after the ventilation is turned on is established as the time required for the dilution and evacuation of gases.
- After such a period has elapsed a first visual inspection of the excavation face will be performed, checking the gas levels by means of an appropriate meter.
● The level of $O_2$ must be above 19.5 %.
● The gas concentrations must be below the levels established by the applicable legislation (NOx: 5 ppm – CO: 50 ppm – CO2: 5000 ppm).
● Once the gases have been sufficiently diluted, the condition of the face shall be verified, checking for the presence of any remaining explosives.
● No-one will be allowed to access the face until authorised to do so by the person responsible for the blast/site manager.

D.- DEBRIS REMOVAL AND TRANSPORT
The material excavated on the face after the blast shall be removed and loaded on trucks and carried to the tip. Debris may be removed by a front-end loader and loaded on a truck, which will carry it to the provisional collection point near the mouths.
Once the debris removal stage has been completed, an inspection of the condition of the ground shall be carried out by the foreman to identify any unstable areas requiring scaling.

**Hazard and Risk Identification:**
- Running over by vehicles.
- Trapping by overturned trucks.
- Exposure to noise.
- Exposure to toxic gases.
- Exposure to suspended dust.
- Falling materials due to unstable ground.

**Safety Rules – Preventive Measures**
- Prior to commencing work it shall be verified that there is no risk of falling loose material from the top or side walls.
- No worker may stand within reach of the machinery.
- The work area shall be sufficiently lit.
- All equipment must be checked prior to starting the debris clearing work to ensure it is in perfect working condition.
All the equipment must be fitted with working lights, reversing sound warning device, rear-view mirrors and flashing light.

The operator of the front-end loader shall keep the way clear of rocks and obstacles to avoid the risk of overturning.

The trucks must not be overloaded to stop any material from falling during transport to the tip or the intermediate collection point.

Communication between the equipment operators and the supervisor of the activity shall be ensured by transmitters or radio communication.

E.- SCALING OF THE FACE

Upon completion of the debris clearing, scaling of the newly excavated front shall commence. To prevent the detachment of rock fragments or slabs due to alteration of the rock mass by natural effects, the entire affected area must be scaled, removing all the loose or unstable rock.

Using a pneumatic drill fitted on a backhoe or using metal bars – if carried out by hand – all the unstable material shall be removed until the entire rock mass is rendered stable. Then all the scaled material shall be cleared away and loaded on trucks for carrying to the tip.

Hazard and Risk Identification:

- Running over by vehicles.
- Flying fragments or particles.
- Trapping by or between objects
- Impacts and wounds caused by machinery, materials or tools.
- Exposure to noise.
- Tripping.
- Falling detached objects.
- Overexertion.
- Exposure to dust.
Safety Rules – Preventive Measures

- Before commencing this task the area shall be surveyed from an already supported safe area to identify rock or ground areas requiring scaling.

- The inspection and scaling sequence on galleries must start from the top and continue on the side walls, in both cases working from the rear towards the excavation face.

- Scaling work shall not commence until any unexploded charges or remains from the previous blast have been removed.

- No worker shall stand within reach of the machines.

- It is strictly forbidden to pass under an area without reinforcement or support due to the high risk of falling detached material.

- The work area shall be sufficiently lit.

- All equipment must be inspected prior to commencing the debris clearing work to ensure it is in perfect working condition.

- The work area must be sealed off to stop any personnel not involved in the work from entering the area.
F.- SUPPORT OR ANCHOR BOLTS

The use of anchor bolts allows the rock mass to support itself by reinforcing the strength of the rock. They generally consist in a metal bar inserted in a bore in the ground and kept in place by friction. Bolts are installed to hold unstable ground against stronger material.

Hazard and Risk Identification:

- Running over by vehicles.
- Flying fragments or particles.
- Trapping by or between objects
- Impacts and wounds caused by machinery, materials or tools.
- Exposure to noise.
- Falling between different levels.
- Falling detached objects.
- Overexertion.
- Exposure to dust.
Safety Rules – Preventive Measures

- Prior to commencing work the rock or ground areas requiring the installation of support bolts shall be identified.
- The work area shall be sealed off using ribbons or cones.
- The area must be sufficiently lit and clear of any rocks or obstacles.
- Any workers standing on worker elevating platform must use fall protection equipment (safety harness).
- The jumbo hammer shall be used to drill the holes in the rock for the installation of the anchor bolts.
- The shaft must be inserted into the bore until the spreader plate is in contact with the ground.
- Once the shaft is in the bore, pressurised water, cement slurry or resin is pumped into it to consolidate and secure the shaft in the ground.
- It is not allowed to use one’s hands to stop rotating shafts, bolts or drills, and gloves must be worn to avoid cuts and thermal contact.

TRUSSES OR HOLDING FRAMES

Trusses are metal elements braced to each other, which are placed against the newly excavated ground to counteract the push of the rock mass. The use of trusses or frames is required when the excavated rock is very highly fractured, making highly likely the fall of large blocks that cannot be held by means of anchor bolts and gunnite or shotcrete.

Hazard and Risk Identification:

- Running over by vehicles.
- Trapping by or between objects.
- Impacts or wounds caused by machinery, materials or tools.
- Exposure to noise.
- Falls between different levels.
- Falling detached objects.
- Overexertion.
Safety Rules– Preventive Measures

- The work area shall be sealed off using ribbon or cones.
- The area must be sufficiently lit and clear of rocks or obstacles.
- Workers shall not be allowed to stand within reach of suspended loads.
- The raising and positioning of the frame shall be carried out using the raising equipment or backhoe, taking the truss to its final position.
- The truss will be firmly secured in place by means of braces to the previous frame or against the ground.
- It is not allowed to steer the suspended load with one’s hands; guiding ropes shall be used.
HOLDING MESH INSTALLATION

In order to avoid the possibility of rock surface fractures and prevent accidents caused by the fall of such fragments, the holding system must be reinforced through the installation of mesh or mesh sections along the tunnel perimeter.

Hazard and Risk Identification:

■ Running over by vehicles.
■ Trapping by or between objects.
■ Impacts or wounds caused by machinery, materials or tools.
■ Exposure to noise.
■ Falls between different levels.
■ Falling detached objects.
■ Overexertion.

Safety Rules – Preventive Measures

■ The work area shall be sealed off using ribbon or cones.
■ The area must be sufficiently lit and clear of rocks or obstacles.
■ Workers shall not be allowed to stand within reach of suspended loads.
An elevating platform will be used, with a rigid roof on which the mesh sections will be previously placed and secured.

Workers must wear a safety harness, gloves and protective hard hat.

The mesh must be perfectly fitted onto the tunnel side wall before going on to install subsequent sections of mesh.

A wireless communication system shall be in place between the lifting equipment operator and the workers on the working platform.

**GUNNITE OR SHOTCRETE APPLICATION**

Gunnite or shotcrete is one of the basic elements in the execution of tunnelling and mine underground works, in the stabilisation of rocks and floors and in the repair of concrete structure.

The shotcrete shall be applied by the wet process and its thickness shall vary according to the type of holding application required, using a robot capable of mixing the three fluids making up the shotcrete (air, concrete and accelerator) and spraying it at great speed against the surface requiring to be protected and sealed.

**Hazard and Risk Identification:**

- Running over by vehicles.
- Trapping by and between objects.
- Impacts and wounds caused by machinery, materials or tools.
- Exposure to noise.
- Flying particles
- Falling detached objects.
- Exposure to dust
Safety Rules – Preventive Measures

- The work area shall be sealed off using ribbon or cones.
- The area must be sufficiently lit and clear of rocks or obstacles.
- Prior to commencing the condition of all the hoses and ducts shall be checked to verify that they are equipped with safety latches.
- Workers must wear full facemasks and ear protection throughout the entire process.
- The equipment shall feature a remote control system allowing the operator to work from a safe position.
- It is forbidden to disconnect hoses and ducts before verifying that the fluid held in them is not under pressure.
- The concrete shall be applied evenly, avoiding excessively thick areas prone to instability on account of their own weight.
- The application of shotcrete shall start from the bottom of the side walls, and provided that there is a safe area to avoid the risk of detachment of rocks or improperly scaled material.
8.2. ANCILLARY INSTALLATIONS

The execution of tunnel construction works requires a set of ancillary installations allowing proper operation of the machinery. These include a constant supply of water for drilling, electric power to keep the lights and ventilating equipment running, etc.

It is therefore necessary to provide for an area in the vicinity of the tunnel mouth in which to install all these essential elements, which must be available before the excavation work can commence.

A.- POWER GENERATORS

Due to their location, tunnels are often situated far from population centres, making it difficult to supply them with power directly from the electricity grid. Therefore, portable electricity generators must be used, the number and power rating of which will depend on the power requirements of the drilling machinery used and the ventilation and lighting systems.

Prior preparation of the area before the generators can be installed includes a suitable concrete floor, a perimeter fence to ensure that only authorised personnel will enter the enclosure, suitable fire extinguishing equipment, and “electric hazard” signs.
Hazard and Risk Identification:
- Flying particles.
- Exposure to noise.
- Direct electric contact
- Indirect electric contact.
- Exposure to noxious substances.
- Fire and explosions.
- Falls caused by tripping.

Safety Rules – Preventive Measures
- Prior preparation of the area with a concrete floor.
- Perimeter fencing isolating and separating the facility from all other areas
- Access gate with locking device to prevent unauthorised access.
- Roofing to shelter the generators from adverse weather conditions.
- Hazard and preventive measure signs.
- A sign with the “five golden rules” of electricity shall be placed in a prominent location.
- An installation project for the generator must be drawn up by a competent technical expert when the generator power rating exceeds 10 kilowatts.
- Fire extinguishing equipment sized according to the fire load shall be placed in an accessible location beside the entrances.

B.- COMPRESSOR / PRESSURE EQUIPMENT
The application of shotcrete as a holding element requires a compressed air installation consisting of a compressor capable of assuring this type of power supply.

Hazard and Risk Identification:
- Falls between different levels.
Exposure to noxious substances.
Falling material due to instability of the ground.
Falls when climbing up to or down from the equipment.
Impacts and/or running over by moving equipment.
Overexertion.
Explosions caused by handling of detonating material.

Safety Rules – Preventive Measures
- Prior preparation of the area by laying a concrete floor
- Perimeter fencing and roofing to isolate, separate and shelter the facility from adverse weather conditions.
- Access gate with locking mechanism to prevent unauthorised entry.
- Roofing to shelter the generator from adverse weather conditions.
- Risk and preventive measure signs.
- Regular checks shall be conducted on the safety valves, which must be free from any element preventing them of opening in the event of excess pressure. Their adjustment may not be altered under any circumstances and their tamper seals must remain intact.
- All the pressure generating equipment components must be CE marked and have undergone regular pressure tests.
- If the installation $P(\text{bar}) \times V(\text{litre})$ exceeds 25,000, an installation project and commissioning certificate issued by an EIP2 authorised firm will be required.
■ The couplings and valves must be protected by holding devices preventing any movement in the event of their coming loose.

C.- VENTILATION EQUIPMENT
An artificial air blowing ventilation system shall be installed for the “cul-de-sac area” to renew the air when work is under way in this area. The ventilator system shall blow the air from the cul-de-sac to the area close to the suction ventilator, generating an air current with a sufficient flow rate to maintain the oxygen and gas concentrations at suitable levels.

**Hazard and Risk Identification:**
- Falls caused by tripping.
- Falls between different levels.
- Impacts from suspended loads.
Cuts caused by objects or tools.
Electrical contact.
Exposure to noise.

Safety Rules – Preventive Measures

- The ventilator structure shall not be assembled until the structure calculation project has been duly reviewed and approved.
- The location of the ventilator must ensure the supply of fresh air inside the tunnel.
- The assembly and disassembly of the ventilator on its support structure shall be carried out from mobile elevating work platforms (MEWPs); it is strictly forbidden to climb up the metal structure.
- Always use the appropriate personal protective equipment (PPE) for each task.
- Check the control panel and instrument panel to ensure that all the safety, measurement and control devices are operational.
- A log book must be kept in which all the air volumes and flow rates must be recorded.

D.- DIESEL FUEL TANKS

These will consist of an array of mobile diesel fuel tanks located in the ancillary installations area to supply the power generators and compressors required for the tunnel excavation, lighting and ventilation systems.

The selected location must have a concrete slab to avoid soil contamination in case of accidental leakage; in addition, the tanks must be protected by a leakage trough.

Hazard and Risk Identification:

- Running over by Vehicles.
- Trapping by overturned trucks.
- Exposure to noise
■ Exposure to toxic gases
■ Contact with noxious substances
■ Fire and explosion

Safety Rules – Preventive Measures

■ An installation project must be submitted for tanks with a storage capacity exceeding 3,000 l, in addition to which a commissioning permit must be obtained.
■ Perimeter fencing and roofing must be in place to isolate, separate and shelter the installation from adverse weather conditions.
■ Access gate with locking mechanism to prevent unauthorised entry.
■ Safety signs shall be posted indicating: fire hazard, combustible and flammable material, do not refuel with the engine running, no smoking.
■ Fire extinguishing equipment sized according to the fire load shall be placed in an accessible location by the entrances.

E.- LIGHTING AND SWITCHBOARDS

Lighting, both in access routes and the work areas and exterior, is one of the most important safety factors.

To reinforce the lighting in the work area (tunnel interior), halogen work lights of
more than 500W are used, connected to the work area Distribution Cabinets. The lighting of the tunnel throughout its length is provided by IP-65 light fittings with 36 W fluorescent tubes, fitted with protective shields.

**Hazard and Risk Identification:**
- Impacts and wounds caused by machinery, materials or tools.
- Exposure to noise.
- Falls due to tripping.
- Falling objects detached from the ground.
- Overexertion
- Direct and indirect electrical contact

**Safety Rules – Preventive Measures**
- The light fittings shall be installed on the side walls, leaving a 10m spacing between them.
- They will consist of IP-65 light fittings with 36 W fluorescent tubes, fitted with protective shields.
- Emergency lights will be installed on a 1:4 ratio, to ensure safe evacuation of the tunnels in the event of an emergency.
- In drift intersection areas or stockpiling or installation areas, halogen or similar floodlights shall be installed to ensure suitable lighting of such areas.
Secondary electrical switchboards within the tunnel shall be fitted with a red indicating light to signal their location.

On the excavation faces work switchboards shall be used; these must be suitably signposted and protected against impacts and falling materials.

A "ground line" shall be installed along the tunnel to provide suitable protection against any current leakage.

Every switchboard must be equipped with portable CO2 fire extinguishers, which must be in an accessible, identified location.

Work on switchboards and electrical installations in general on the site may only be performed by authorised personnel.

F.- WATER/AIR/DRAINAGE DUCTS
As the excavation and holding work advances, the installations must be extended to ensure the continued availability of electric power, water or compressed air for the work teams.

Hazard and Risk Identification:
- Running over by vehicles.
- Flying fragments or particles.
- Trapping by or between objects
- Impacts and wounds caused by machinery, materials or tools.
- Exposure to noise.
- Falls between different levels.
- Falling objects detached from the ground.
- Overexertion.

Safety Rules– Preventive Measures
- Water, air and drainage ducts must be anchored to the tunnel side walls.
- Racks will be used for the proper placing of ducts.
The type of fluid or power carried by each duct must be identified every 100 m, and intermediate safety valves and stopcocks must be installed.

The order of placement shall be: electricity / air / water / drainage.

No crossing over of installations along the side walls is admissible.

Routing of installations to the other side of the tunnel shall always be across the tunnel roof and each duct must be properly secured to the tunnel lining.

Electrical ducting must be kept at minimum safety distances from water ducts.
G.- WATER EVACUATION / PUMPING SHAFTS

The inflow of water from the rock mass in certain tunnels, in addition to the water released during drilling operations, calls for the design and installation of pumping stations and piping to carry this water outside the tunnel.

Hazard and Risk Identification:
- Running over by vehicles.
- Trapping by or between objects.
- Impacts and wounds caused by machinery, materials or tools.
- Direct and indirect electrical contact
- Falls between different levels.
- Falling objects detached from the ground.
- Overexertion

Safety Rules – Preventive Measures
- Water must always be ducted along one of the side walls and must never run freely down the middle of the tunnel.
- Collection points and pumping stations shall be set up as and when required.
- Such pumping stations must be sufficiently lit, and surrounded by rigid barriers to prevent falls and impacts.
- Intermediate points and/or decanting pools shall be in place along the tunnel to improve the quality of the water extracted from the tunnel.
- The condition of the pumps and drainage ducts shall be regularly checked to avoid blocking and overflowing.
- The water must be treated prior to its release into the natural environment, by means of a suitable treatment and decanting pool.
H.- FIRE FIGHTING / EVACUATION AND EMERGENCY SYSTEMS

Given the large amount of machinery used for tunnel excavation and wall holding work, and the high levels of risk exposure involved in underground work, all tunnels must have suitably sized fire fighting and evacuation resources to face an emergency situation.

**Hazard and Risk Identification:**

- Fire
- Explosion
- Running over by vehicles
- Falling detached material due to ground instability
- Falls between different levels

**Safety Rules – Preventive Measures**

- Prior to commencing underground work, an emergency and evacuation plan must be in place.
- All personnel must receive training in and be conversant with the existing emergency measures and fire fighting systems.
- An emergency kit must be available in all work areas, including the following items: rescue stretcher, spinal board, cervical collar, first aid kit, blankets.
- An access checkpoint shall be installed outside the tunnels to identify all personnel working inside the tunnels.
- A radio communication system shall be used, and all the chain of command must comply with the mandatory requirement to always carry their transmitters with them whenever they are inside the tunnel.
- A pushbutton-operated sound warning system shall be in place at 500m intervals to warn of any incidents requiring the evacuation of the tunnels.
- All moving equipment must be equipped with portable multi-purpose fire extinguishing devices.
- All switchboards and/or power generators shall be equipped with fire extinguishing devices suitable for electrical fires.

- Evacuation routes shall be signposted and location maps shall be placed along the tunnels and drifts.
IF YOU BECOME AWARE OF AN EMERGENCY

- Report it to your closest immediate supervisor.
- Try to address the emergency, provided that suitable means are available and this can be done in a safe manner.
- Keep calm.
- Remember that you must never compromise your physical integrity.

WHAT TO DO IN AN EMERGENCY

In the event of an accident you must PROTECT, REPORT and ASSIST (PRA). Do not touch the victim unless you are trained in first aid, and call the site medical service.

MEETING POINTS

These are the points where personnel evacuated from nearby areas subject to an emergency (partial or general) must gather in order to be accounted for. Never leave the meeting point until an emergency is declared to be over.

BASIC FIRST AID RULES

1. Keep calm.
2. Avoid crowding.
3. Assert yourself.
4. Do not move the victim.
5. Examine the victim.
6. Calm the victim.
7. Keep the victim warm.
8. Call for medical assistance.
10. Do not administer medication.
### Site

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### Internal Telephone Numbers

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### Healthcare Centre/Hospital Addresses

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Useful Telephone Numbers and Addresses
I have received the following information:

☐ “Safety and Health Manual”

The content of the above instructions has been explained to me, especially as regards the tasks that I will normally be carrying out.

I acknowledge that this Document constitutes an INTERNAL COMPANY RULE, and undertake to effectively implement it within my area of responsibility.

In _____________________ on ___ ____________ , 20 ___