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3 SAFETY PRECAUTIONS

3.1 SAFETY PROGRAMME AND ITS IMPLEMENTATION

- i) Within 28 days from the date of issue of the Notice to Commence, the Contractor shall submit, in writing, his proposal for a comprehensive safety programme covering all aspects of the Works.
- ii) This safety programme shall detail policies, procedures, and plans which the Contractor intends to implement to ensure the safety and health of his employees. It shall comply with the standards and regulations in force in the State of Uttarakhand, India applicable to construction safety.
- iii) Contractor shall designate a competent manager specially trained and experienced to act as Safety Officer, who will administer and be responsible for the implementation of the safety program. He shall carry out frequent and regular safety inspections of the working areas, materials, and equipment. The name and qualifications of the Safety Officer shall be submitted for approval to the Project Manager prior to his appointment.
- iv) Contractor shall be responsible for enforcement of the health and safety provisions for his subcontractors to be employed at the Site.
- v) Prior to the start of any major construction activity or hazardous operation, the Contractor shall submit to the Project Manager for approval, a specific plan for safety precautions covering such operation.
- vi) All accidental occurrences with serious accident potential such as major equipment failures, contact with high-voltage lines, and exposure to hazardous materials, slides, cave-ins, etc., shall be immediately reported to the Project Manager.
- vii) All serious and fatal injuries and diseases caused by the progress of work shall be immediately investigated by the Contractor and a comprehensive report shall be submitted to the Project Manager.

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- viii) In case of a fatal accident, only rescue and emergency teams and operations shall be permitted at the place of the occurrence until the Project Manager gives permission to resume normal operations.

3.2 SAFETY STANDARDS

In addition to the requirements specified herein, the Contractor shall comply fully with all applicable national and state governments safety regulations and standards in force in India, as well as with the:


- a) Safety standards of the U.S. Bureau of Mines,
- b) U.S. Bureau of Reclamation Construction Safety Standards.

3.3 PERSONAL SAFETY EQUIPMENT

3.3.1 GENERAL

- i) Contractor shall provide his and his subcontractor's personnel, as well as, the Project Manager's representatives and visitors with appropriate personal safety equipment. The use of such equipment shall be compulsory.
- ii) Every person entering the working area in open air or in underground shall wear a protective helmet and Illumination device.
- iii) The safety-toe footwear with steel caps shall be worn by all employees engaged in work having an inherent danger to the feet. Light footwear such as sandals, canvas or tennis shoes shall not be permitted for construction work.
- iv) During the drilling works and in the areas where the employees are exposed to harmful noise levels, ear protectors shall be made available and required to wear.
- v) Employees engaged in work having an inherent danger of eye or face injury shall be furnished and required to wear protection glasses, goggles or masks. Where irritant or toxic substances may come in contact with the skin or clothing, employees shall be wearing the protective clothing or shall be required to apply a protective ointment by a competent physician.

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- vi) Employees working on steep slopes or otherwise subject to possible falls from levels not protected by fixed guard-rails or safety nets, shall be secured by safety belts and lifelines.


3.3.2 REQUIREMENTS FOR UNDERGROUND WORKS

- i) Emergency material shall be provided at each underground excavation heading. This equipment shall consist of the following, as a minimum:
- a) 3 stretchers,
 - b) 3 woollen blankets,
 - c) 2 appliances for artificial breathing,
 - d) 1 oxygen flask,
 - e) 3 explosion-proof lamps,
 - f) wound dressing and disinfecting material,
 - g) pain-killing injections,
 - h) gas masks.
- ii) At least two members of the Rescue Team as described hereinafter, properly instructed and trained in the rescue procedures, shall be in each crew working underground.

3.4 RESCUE TEAM

- i) Prior to the commencement of construction, the Contractor shall organise and train a Rescue Team composed of his employees. This Rescue Team shall be capable to render help after accidents caused by fire, gas, explosion, avalanche, etc.
- ii) The Rescue Team shall be organised in such a way that sufficient number of members will be ready for action at any time until the Completion of Works.
- iii) The Rescue Team members shall be instructed and trained for their task by a qualified and experienced person. If required, the Contractor shall hire an outside specialist to perform such training. Refresher training for all members of the Rescue Team shall be conducted at least every six months.

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- iv) Each Rescue Team member shall be skilled in giving the first aid, dealing with the appliances for artificial respiration, and fire fighting equipment and shall possess a good local knowledge. Adequate equipment for reaching even the remotest working area shall be at their disposal.

3.5 ILLUMINATION AND EARTHING


3.5.1 GENERAL

All working sites in the open, transit areas, excavation sites, access to tunnels, etc., shall be adequately illuminated during night work by electrical lights as specified in the Section "Site Installations and Services".

3.5.2 ILLUMINATION OF UNDERGROUND WORKS

- i) Each working face shall be brightly illuminated.
- ii) The vaults along the entire length of the tunnel shall be illuminated with electrical light throughout the duration of construction works. The lamps shall be located as follows:
 - a) every 25 m in unlined stretches,
 - b) every 50 m in lined stretches.
- iii) Each lamp shall be 60W minimum. The lamps shall be installed in a particular area immediately after the rock supporting measures have been completed.
- iv) Electrical cables shall be well insulated, protected and firmly fixed to tunnel walls by means of adequate insulators. Lamps shall be well protected against damage.
- v) Lighting by flame is expressly forbidden in the underground.

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3.5.3 EARTHING, WET WORK AREAS, CONTROL OF ELECTRIC DISCHARGES

- i) All equipment and appliances, which are exposed to lightning shall be earthed electrically; and the effectiveness of such earthing shall be periodically checked by the Contractor's specialised personnel.
- ii) No equipment electrically powered by more than 24 Volts shall be operated by personnel standing in water.
- iii) Only air, battery-powered or hydraulic tools shall be permitted in wet areas.
- iv) Where electrical blasting will be used, equipment shall be installed to control possible electric discharges in the ground due to storms, electrical motors, etc. As soon as such discharges are noted, electrical blasting operations shall be suspended, or the detonator type changed.

3.6 MAINTENANCE OF TRAFFIC AND SAFETY ON PUBLIC ROADS

- i) Contractor shall be responsible for the safety along the roads related to the Site, and he shall take all necessary precautions for the protection of the work and the safety of the public on the roads affected by his activities. Where work will be carried out at the site of, or close to an existing road, the Contractor shall maintain the vehicular and pedestrian traffic safe at all times. If his operations can cause traffic hazards, he shall repair or fence or take such other measures for ensuring safety.
- ii) Roads subject to interference by the work shall be kept open or suitable detours shall be provided and maintained by the Contractor, who shall provide, erect, and maintain all necessary barricades, suitable and sufficient flashlights, flagmen, danger signals, and signs.
- iii) Roads that will be closed to traffic shall be protected by effective barricades on which acceptable warning and detour signs shall be placed. All barricades and all lights shall be kept burning from sunset to sunrise.
- iv) Contractor shall submit his weekly activities schedule and the locations of his work along the existing public roads to the authorities concerned, and

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obtain all necessary approvals prior to commencement of the respective work.

- v) At road crossings or in heavy traffic locations, the Contractor shall carry out the work during the working hours as directed by the Project Manager, and after the completion of the work he shall immediately make the necessary backfill and pavement at the crossings.
- vi) Contractor shall provide temporary passes and bridges to give an access to the existing villages, houses, etc., to the satisfaction of the authorities concerned whenever he disturbs such existing way during the execution of the Works.

3.7 STORAGE AND TRANSPORT OF EXPLOSIVES

- i) CONTRACTOR shall arrange for the explosives & portable magazines required for the work, permits/approval etc. If required from the authority, shall be extended by the OWNER without any extra cost to Owner alternately.
- ii) Contractor, at his own cost, shall take the responsibility to collect and transport explosives from the Owner's magazine and to own portable magazine(s) and to store explosive materials for their day to day consumption. The Contractor shall also own requisite number of explosive vans to carry explosive materials to their various working fronts. Sufficient number of licensed professional blasters shall be deployed by the Contractor for safe handling of explosives from the time of receipt till the consumption in totality. The Contractor shall comply with all relevant provision of law, such as Indian Explosive Act 1940 with amendments thereto.
- iii) Explosive magazines shall be reinforced concrete buildings with walls and slabs of a minimum 250 mm thickness. Doors shall be made of double sheets having a minimum thickness of 5 mm each and shall be fitted with safety type locks.
- iv) Explosives magazines shall be kept at a safe distance from working areas and living quarters. They shall be surrounded with barbed wire, protected by


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safety locks, ventilated, and fitted with lightning arrestors. An air space shall be provided between the ceiling and the roof to prevent temperatures from reaching dangerous levels.

- v) Blasting caps and detonators shall not be stored in the same magazines as explosives, but shall be located in separate magazines at least 15 m away if barricaded and 30 m if not barricaded.
- vi) Explosives shall be stored only in their original containers and with the top side up as designated on the container.
- vii) Access to the magazines and permission to handle explosives shall be granted exclusively to trustworthy personnel, adequately instructed and experienced in the use and handling of explosives.
- viii) No explosives may be stored in the tunnels, galleries, caverns or shafts.
- ix) The Contractor shall provide all reasonable and adequate security measures necessary to prevent loss or theft of explosives. Storage of explosives and detonators outside of the magazines shall not be permitted.
- x) The Contractor shall maintain a record of storage and withdrawal of all explosives. The Project Manager shall be promptly notified of any loss or theft of explosives.
- xi) Between the magazines and the place of use, the explosives and detonators shall be transported separately in lockable metallic containers loaded on a special wagons designated for the purpose of explosives transport only. These wagons shall be painted with striking colours for easy recognition. The inside of the containers shall be lined with wood in order to prevent a direct contact of the explosive or detonators with the metal.

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3.8 BLASTING

3.8.1 GENERAL

- i) All blasting shall be carried out in a workmanlike and safe manner by a competent, licensed and experienced blasting engineer or foreman. No blasting shall be done without his approval.
- ii) Blasting will be permitted only after adequate provisions have been made for the protection of persons, the Works, and public or private property. The Project Manager approval of any of the Contractor's blasting operations shall not relieve the Contractor of his sole responsibility for the safety of persons and property. The Contractor shall be liable for all claims resulting from personal injury and damage to property and equipment that may result from its blasting operations. Any damage done to the Works or property by blasting shall be repaired by the Contractor.
- iii) Blasting in the open air shall be carried out only at certain hours of the day in accordance with a schedule mutually agreed upon by the Contractor and the Project Manager. Barriers shall be erected and warning signal shall be given to the workers at the Site and to the public immediately before blasting, so that no person will enter the danger zone until blasting is finished. Any restriction imposed on the blasting schedule to ensure safety of structures, properties and lives shall not be accepted as a basis for any claim by the Contractor.
- iv) Upon completion of blasting, an "all clear" signal shall be given by the responsible blasting engineer after he has satisfied himself that all charges loaded have detonated and that no delay-explosions or misfirings are to be expected.
- v) Such methods of blasting shall be employed in order that shock and vibration are minimised.

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<div> <div>vi)</div> <div>No blasts involving charges larger than 200 kg shall be carried without the written approval by the Project Manager, who shall be notified at least one hour prior to the blast.</div> </div> <div> <div>vii)</div> <div>No blasting shall be permitted within 25 m of any concrete placed within the previous 7 days. After 7 days, blasting may be performed only with the approval of the Project Manager. Blasting will not be permitted within 10 m of structures or installations vulnerable to damage by blasting.</div> </div> <div> <div>viii)</div> <div>No charging and firing will be permitted during thunderstorms and other electrical disturbances.</div> </div> <div> <div>ix)</div> <div>Mats or rubber tires tied together with rope shall be used as protection from flying debris to cover the charges where blasting may expose persons or property to injury or damage.</div> </div> <div> <div>3.9</div> <div><u>VENTILATION OF UNDERGROUND WORKS</u></div> </div> <div> <div>3.9.1</div> <div><u>GENERAL</u></div> </div> <div> <div>i)</div> <div>The Contractor shall design, furnish, install and operate a ventilating system for each underground construction site, and provide a tunnel atmosphere monitoring system. Details of the proposed systems shall be submitted to the Project Manager for approval within 28 days after the day of receipt of the Notice to Commence. This updated design shall include all calculations of fresh air supply volume, type of ventilation scheme, duct diameters, materials and equipment and position of ventilators and dust arrestors. Description of the working cycle including number of persons employed, number and capacity of diesel-powered equipment working at one time at each heading face shall also be included. The design shall be consistent with the proposal submitted by the Contractor with his Tender, as well as, with any subsequent amendments and additions agreed to by the Project Manager and the Contractor.</div> </div> <div> <div>ii)</div> <div>All parts of the Works shall be maintained in a state that will not be injurious to the health of the personnel. The air in underground sites shall contain no</div> </div>		
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less than 20% oxygen and shall not contain a concentration of gases, vapours or dust greater than is safe for the health of workmen.

- iii) If required, the ventilating system shall be kept in operation also after break-through in tunnels and galleries in order to maintain the fresh air volume requirements stated hereafter.
- iv) Intermediate fans attached to the main duct line shall be provided as required to ensure satisfactory removal of contaminated air. All ventilation ducts shall be maintained in an airtight condition.
- v) Ventilation ducts shall be firmly fixed to the vault in such position that a minimum clearance of 200 mm remains between the duct and the extremities of train or vehicular traffic employed in the underground.
- vi) The Contractor shall check the amount of fresh air at the heading face after each 200 m of progress, but at least once per month. The check of the airtightness of joints and control of the air ducts for leaks shall be performed periodically. Any deficiency discovered or reported by the Project Manager shall be immediately repaired by the Contractor.
- vii) Should the volume of fresh air at the heading face not reach the required amount and quality, the whole duct system shall be pressure-and-volume tested in portions not exceeding a few hundred meters. Measuring stations shall be located not closer than 10 times the duct diameter from any fan or other flow disturbance within the duct.

3.9.2 VENTILATING SYSTEM


- i) The ventilating system shall be of such efficiency that the average air velocity in the largest excavated profile is not less than 0.3 m/s. In case the presence of methane gas is detected or suspected this value shall be increased to 0.5 m/s.
- ii) Furthermore, the main ventilating system shall ensure that both of the following minimum fresh air volume requirements are satisfied at all times:
 - a) 3.0 m³/min for each person employed underground at one time,

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- b) 6.0 m³/min for each metric horsepower (PS) of diesel-powered equipment at work underground at one time. This value may be reduced to 4.0 m³/min providing the equipment is using diesel oil low in sulphur content (max. 0.2% of sulphur by volume).
- iii) These fresh air volumes shall be cumulative and the Contractor shall allow in his design calculations for the maximum number of persons and diesel-powered equipment working in the underground at any one time. Any estimated losses, e.g. due to the leaks in the ducts, shall be added to the figures stated above.
- iv) The ventilating system in the underground excavation performed by drilling and blasting shall consist of two parts:
 - a) Main ventilating system,
 - b) Secondary ventilating system.
- v) The main ventilating system shall be designed to allow the flow to be reversed and shall be operated as follows:
 - a) Prior to the blasting, the system will be put in the exhaust mode of operation. Blasting fumes shall be extracted as close as possible to the excavation face. Exhaust air and blasting fumes shall be discharged in such a way that they cannot neither escape in any other working place nor be recirculated in the fresh air supply system,
 - b) Prior to the commencement of mucking and removal of material the system will be put in the forced mode of operation, which will continue till termination of mucking.
- vi) The secondary ventilating equipment of the forced type shall be installed to provide an adequate ventilation of the area between the heading face and the air intake/outlet of the main system. This system shall be switched on prior to the blasting and shall be operating until the main system has been put into forced mode of operation. The air intake shall be located at a sufficient distance from the heading face to ensure that blasting fumes do

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not permeate into this area and cause a recycling of blasting fumes. The outlet of this duct shall be located so close to the heading face that the driving of the blasting fumes and dust away from the face into main system is ensured. The minimum capacity shall be at least 70% of the main system capacity. The end diameter of the duct shall be such that the air discharge velocity is not less than 20 m/s.


- vii) Re-entry to the heading face and resuming of the work may not occur earlier than 15 minutes following each blast.

3.10 CONTROL OF DUST, SILICA, AND NOXIOUS GASES IN UNDERGROUND WORKS

3.10.1 DUST AND SILICA

- i) To reduce the amount of dust, only wet drilling will be allowed and during mucking, muck tips shall be kept constantly damp by sprinkling with water. The use of high pressure water jets for this purpose will not be permitted.
- ii) The Contractor shall measure the concentration of fine dust and content of silicon dioxide (SiO₂) in all dust-producing underground operations by an approved method.
- iii) Air samples shall be taken within 10 days of commencing underground excavation, and at 90 day intervals thereafter. Further, within 30 days following major changes in tunnel excavation operation, or whenever required by the Project Manager. Samples shall be taken from actual working areas. The sampling and testing shall be performed by a qualified person or laboratory to be proposed by the Contractor and approved by the Project Manager. A copy of the test results shall be submitted to the Project Manager within 2 weeks of the sampling date.
- iv) The concentration of fine dust (diameter less than 0.005 mm) may not in general exceed the value of 8.0 mg/m³ of air and in relation to the silicon dioxide content in the rock this value is lowered as follows:

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Content of SiO ₂ in fine dust in percent by weight	Concentration of fine dust in milligrams per m ³ of air
1 - 15%	8.0 mg/m ³
20%	6.0 mg/m ³
30%	4.0 mg/m ³
60%	2.0 mg/m ³
80%	1.5 mg/m ³
100%	1.3 mg/m ³


- v) Should the concentration of fine dust exceed the limits stated above, the Contractor shall undertake such necessary measures and install such additional equipment, which will ensure that the dust concentrations are within the specified safe hygienic limits.

3.10.2 NOXIOUS GASES

- i) Use of internal combustion engines, other than approved mobile diesel-powered equipment will not be permitted in underground construction sites.
- ii) The Contractor shall provide and maintain equipment for measuring the content of noxious gases and oxygen at each heading face throughout the duration of excavation works. Tests for determining concentrations of carbon monoxide, carbon dioxide, nitrogen dioxide, methane, other flammable gases, and oxygen shall be made before and after each blasting and at the beginning of each shift by qualified personnel. A record of readings shall be maintained and be available to the Project Manager on request.
- iii) Gas concentrations in underground sites may not exceed the following limits:
 - a) 0.0025% (twenty-five ppm) of carbon monoxide,
 - b) 0.5% (five thousand ppm) of carbon dioxide,
 - c) 0.0003% (three ppm) of nitrogen dioxide,
 - d) 0.001% (ten ppm) of hydrogen sulphide.

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	<ul style="list-style-type: none"> - Whenever hydrogen sulphide levels exceed 5 ppm (0.0005%) tests for hydrogen sulphide shall be conducted in the affected areas every 4 hours, - If hydrogen sulphide levels exceed 10 ppm (0.001%) a continuous sampling hydrogen sulphide indicator with alarm shall be used to monitor the work area, - If the concentration of hydrogen sulphide exceeds 10 ppm (0.001%) TWA for an 8-hour period, steps shall be taken to increase ventilation to reduce the concentration. <p>e) 0.01 milligrams per litre of nitrous oxide</p> <p>f) 1.0% (ten thousand ppm) of methane or not greater than 20% of the lower explosive limit.</p> <ul style="list-style-type: none"> - Whenever 5% or more of the lower explosive limit for methane or other flammable gases is detected, steps shall be taken to increase the ventilation rate, or other steps shall be taken to lower the methane concentration, - Whenever 10% or more of the lower explosive limit for methane or other flammable gases is detected in the vicinity of welding, cutting, or other "hot work", such work shall be suspended, - Whenever 20% of the lower explosive limit for methane or other flammable gases are detected, all employees except those necessary to eliminate the hazard shall be evacuated and electrical power except for explosion proof pumps and ventilation equipment shall be disconnected. <p>iv) Concentrations of flammable gases other than methane shall not exceed 20% of the lower explosive limit at the heading face and the total of all flammable gases including methane shall not exceed 20% of the lower explosive limit in the general tunnel atmosphere.</p> <p>v) If concentrations of noxious gases or other flammable gases exceed the permissible limits set forth above, all operations shall be interrupted</p>	<div style="border: 1px solid black; padding: 5px; text-align: center;"> ISSUE P0 </div>

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immediately and personnel shall be removed to a safe area. All sources of ignition shall be extinguished or removed. All equipment, with the exception of ventilation equipment and explosion proof pumps, shall be shut down.

- vi) The required measures will be mutually determined and agreed by the Project Manager and the Contractor. In case of need, the Contractor shall engage the services of an independent consultant experienced in gaseous tunnelling. Re-entry and resuming of the work shall be prohibited until the Project Manager has authorised re-entry in writing.


3.11 FIRE PRECAUTIONS

- i) The Contractor shall organise a fire brigade equipped for the fighting of any fires which could break out on the construction sites, in temporary structures, stores, residential quarters, etc.
- ii) An adequate number of fire extinguishers shall at all times be available at each construction site and in each building in camps and in offices and they shall be kept in satisfactory working order.
- iii) Fire fighting equipment shall be of the gas, dry powder or other suitable chemical or pumped water type. Their number, type and location will be subject to the approval of the Project Manager.

3.12 DUST ABATEMENT

- i) During the performance of the work and any operations appurtenant thereto, the Contractor shall carry out proper and efficient measures, such as sprinkling with water or other means, whenever necessary to reduce the dust nuisance, and to prevent dust which has originated from his operations from damaging crops, cultivated fields, and dwellings, or causing a nuisance to persons. The Contractor will be held liable for any damage resulting from dust originating from his operations.

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3.13 MEASUREMENT AND PAYMENT

- i) No extra measurement for payment or payment whatsoever will be made for the safety precautions required to be provided by the Contractor and the entire cost thereof shall deemed to be included in the Unit Prices for other items of the Works.
- ii) Any repair work or any indemnities required due to Contractor's non-compliance with the safety requirements shall be at the Contractor's expense.

End of Chapter

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