

# **RISK ASSESSMENT AND SAFETY MANAGEMENT PLAN**

## **1. Risk assessment**

Risk assessment is the pro-active identification of hazards. An action plan to control the hazards in order of priority as assessed will be documented. The action plan will be monitored on a regular basis.

Identified risks are to be managed to ensure their reduction to a level “As Low As Reasonably Practicable” (ALARP)

Eliminate - Through design options

Reduce - Through choices of materials for construction and operating method

Protect - Through emergency and organizational control

Mitigate -Through effective controls

Monitor -Inspection, Audit, Review

Construction and operating risk that cannot be designed out, should be uniquely identified and tracked through each Project phase, using a “Hazard register” process.

### **Safety plan requirements**

- Risk assessments
- Organisation for safety.
- Safety responsibilities.
- Method of statements
- Procedures & Instructions
- Compliance monitoring
- Inspection, Investigation & Audit
- Corrective actions

### **Areas of safety requirement**

- Excavation & ground support
- Permanent support
- Compressed air working
- Fire and smoke
- Firefighting and rescue
- Ventilation
- Dust
- Underground and surface illumination
- Operating communications
- Noise & vibration
- Lifting equipment
- Access
- Transport & loading
- Tunnel plant
- Electrical failure
- Maintenance & Repair

## **2. Safety measures**

This project does not use any source of radiation and natural background radiation from the rock is very low and well within limits. All electrical equipment will be suitably designed to prevent fire/spread of fire and fast acting interlock and protection system will be provided to isolate the faulty section quickly. Besides, all risks will be assessed on a regular basis with the intention of either reduction or removal. The three most effective measures involve safety audits, staff training and evacuation drills.

## **3. Safety audits**

Safety audits involve checking, as a regular routine, all electrical equipment, wiring, fire extinguishers, hose maintenance, roof leaks, pest infestations, damaged flooring or steps, clearways through fire exits, and more generally ongoing daily OH&S issues. Particular attention will be paid at times of capital works. *Risk assessment, Safety and Health management plan*

## **4. Evacuation drills**

The aim of controlled evacuation drills is to improve performance should a real evacuation occur. Shortcomings in the drills can be addressed during the evacuation stage following the drill leading to increased efficiency and safety during emergency. The knowledge and confidence gained during drills will help in speedier and thorough evacuation. The timing of evacuation drills will be so chosen to avoid potential disruption during critical periods.

## **5. Staff training**

Training the staff dramatically helps to prevent minor or major disasters. If staff are knowledgeable about safety issues, evacuation procedures, fire prevention methods and OH&S practices, the probability of sustaining damage, loss and injury is significantly reduced.

## **6. Emergency management plan**

The Emergency management plans will be updated as required so to accommodate unexpected eventualities.

The posters containing building plan, exit, location of fire extinguisher and evacuation steps will have to be prominently displayed within the caverns and surface buildings for the benefit of both the staff and security.

For management of safety at workplace, four distinct developments can be identified.

- a) Engineering and technical consideration for management of job hazards.
- b) Developing statutory measures and strengthening of suitable enforcing agencies for improvement in the workplace safety.
- c) Incorporating safety as a basic function in the organization and setting up of safety department as an integral part of the work organisation.
- d) Understanding behavioural base of accident potential and evolving of appropriate strategies based on such appreciation.

It is clear that engineering control of hazards and working conditions will constitute the top priority for safety management.

## **7. Health management plan**

- An ambulance will have to be made available by the EPC Contractor at the project site to take the injured persons to the nearby hospital.
- A medical attendant with first aid medical kit will have to be available at the Project site to attend the injured.
- A clause shall be added in the agreement so that the EPC (Engineering, Procurement & Construction) Contractor will have a tie up with the local hospital at Kambam/Theni towns to give medical treatment expeditiously and to provide periodical health check up to the workers.
- All the health protection appliances (viz.) Helmet, Gum boots, etc. will be given to the workers to protect them from dust, noise, rough surface and falling stones.
- All necessary precautions and safety measures will be taken to ensure good health condition of employees.
- The main focus of health management is to ensure 'Zero' Casualty during the Project construction period.
- During the operation period, all safety and health codes prescribed by the BIS will be strictly implemented in the Caverns & Tunnels.

## **8. Fire fighting**

This covers a description of salient features of the different fire protection systems proposed for the caverns.

The fire protection systems proposed comprise the following sub-systems, each one of which will serve as an effective protection against the particular nature of fire risk involved. The fire risks in terms of equipment and facilities locations have been identified and suitable firefighting system have been proposed.

### ***8.1 FM 200 system***

Control room in the cavern-2 being a manned area, it is proposed to provide clean agent system (FM 200) to avoid suffocation at the time of fire.

The technical requirements/material requirements for this system are as given below:

- a) FM 200 cylinders filled with FM 200 gas
- b) Solenoid valve
- c) Gauge assembly
- d) Hoses
- e) Check valves, nozzles
- f) Pressure switch
- g) Seamless schedule 40 pipe with fittings
- h) NRV

### ***8.2 Inert Gas Argon IG-01 system***

Since the activity in Cavern-1 is sensitive to moisture, inert gas fire protection system is proposed. Two sets of cylinder bank arrangement (one set main and one set standby) using

directional valve is proposed. Gas discharge is proposed to be done manually after verifying the real fire condition and by operating the respective manual gas discharge station.

The technical requirements/material requirements for this system are as shown below:

- a) Argon cylinder with valve and filled with Argon gas at 200 bar pressure.
- b) Flexible Hoses, Non Return Valves, Frame Assembly & Header
- c) Pressure reducer
- d) Argon IG-01 Nozzle
- e) Pressure switch
- f) Directional valve of suitable size.

### ***8.3 Portable Fire Extinguishers***

Portable fire extinguishers Class-A, B & C have been proposed in utility building, Assembly shop, surface facilities etc., so as to fight fire in such areas. The technical requirements/ material requirements for this system are as shown below:

- a) 4.5 kg CO<sub>2</sub> type fire extinguisher (Class B).
- b) 5 kg DCP type fire extinguisher (Class B/C)
- c) 9 litre capacity Mechanical foam type fire extinguishers (Class A).

### ***8.4 Fire detection and Alarm system***

#### **Fire detection**

Despite the many precautions taken, fires do break out. Hence all caverns will have established measures to detect a fire and to attack it immediately. Automatic fire detection has been proposed as this has many advantages such as speed and reliability and is recommended for control rooms/ computer rooms and unoccupied areas with high fire hazard. They will be activated by one of the effects of fire such as temperature rise, smoke, flame or heat and will be coupled to an alarm system which will provide visual/audible alarms at designed manned locations. The selection/installation of the detection system will conform to the applicable national standards.

#### **Alarm system**

On receiving the message of emergency from the site, the control room will sound siren “wailing type for 5 minutes”. On receiving the message of emergency over, the alarm will be sounded for 2 minutes. The features of alarm system shall be explained to all during trainings to avoid any confusion. Manual call points with associated alarm panels will be provided at suitable location and the following communication system also plays a major role during emergency.

- a) Telephone system-Intercom and public.
- b) Public address system with communication bus.
- c) Radio paging and walkie-talkie systems.

(i) In **Caverns**, following fire alarm systems are proposed:

- a) Addressable fire alarm panel
- b) Addressable photo detectors
- c) UV Flame detectors
- d) Smoke detectors

(ii) In **Utility building and Assembly shop** the following fire alarm systems are proposed:

- a) Conventional modular type fire alarm panel
- b) Photo Electric type smoke detector
- c) Thermal detector

(iii) In **Gas storage tanks** Quartzite Bulb detector is proposed.

## **9. Prevention of spread of fire**

### **Building and Services**

- The building design will also facilitate safe evacuation of occupants and should conform to the various fire safety recommendations of the National Building Code as well as the Factories Act.
- The building services such as electrical distribution, air handling and conditioning systems, other services will be so laid out as to prevent fire spread. Some of the specific measures include use of non-combustible linings with provision of adequate fire protection stops in cable ducts.
- Fire dampers in A/C and ventilation ducts shall be provided at suitable locations to prevent spread of fire from the functional area to the other areas.

### **Lay-Out spacing**

The project components design will be laid out in such a way as to provide unimpeded access for fire brigade equipment to every part of the underground laboratory.

### **Control of combustible/ flammable/ waste materials**

Safe procedures for the collection and disposal of waste materials particularly combustible wastes will be established and all employees educated in such procedures.

### **Fire Protection Management Plan**

A fire protection Manual will be prepared, preferably in 3-parts.

**The first part** will outline the fire risks in terms of laboratory locations, equipment and facilities and indicate the ways in which risks have been minimized.

The **second part** will set out operating procedures, standards of fire protection established, maintenances of these standards action to be taken in the event of fire by every level of management responsibility for inspection and repair. It will also include instructions for staff responsible for building services.

The **third part will** outline the training required for existing and new staff, the inspection schedules and check lists, sources of additional information and help.

## **10. Safety equipment**

In addition to Fire Extinguishing network, the equipment detailed below are also to be provided for safety against fire.

- a) Canister gas mask
- b) Chemical cartridge type gas mask
- c) Self rescue type gas filters
- d) Mechanical filters for dust nuisance
- e) Resuscitators
- f) Fire proximity suits
- g) Safety Helmets
- h) Face Shields
- I) Gas tight rubber goggles
- j) Torches
- k) Axes/Hand Saw
- l) Fire Blankets
- m) Gloves
- n) Ropes
- o) Ladders
- p) Safety belt

Adapted from the DPR prepared by TANGEDCO (Nov 2010) at [http://www.ino.tifr.res.in/ino//OpenReports/INO\\_civil\\_dpr.pdf](http://www.ino.tifr.res.in/ino//OpenReports/INO_civil_dpr.pdf).