

## 1.1 RISK ASSESSMENT & DISASTER MANAGEMENT PLAN

### 1.1.1 Risk & Its Assessment

**Risk** is the probability or severity of occurrence of a harmful consequence due to hazards.

**Hazard** is a situation that poses a level of threat to life health or environment.

**Disaster** is a natural or man-made hazard resulting in an event of substantial extent causing significant physical damage or distraction loss of life or drastic change in environment.

**Risk Assessment:** Qualitative and quantitative measurement of the potential loss of life, personal injury, economic injury, and property damage resulting from hazards.

**Risk assessment involves the following:**

7.3.1.1 Hazard Identification

7.3.1.2 Vulnerability Analysis

7.3.1.3 Risk Analysis

7.3.1.4 Emergency Plan

The main objective of this Risk Assessment (RA) study for the proposed ropeway is to identify the disasters due to natural causes, human caused occurrences & technical failures and to provide risk mitigating measures to reduce associated hazards.

#### 1.1.1.1 Hazard Identification

Aerial ropeway above chanju nallah may present a number of hazards to the general public, operating and maintenance staff. Ropeway will be liable to suffer from two types of disasters:

#### **NATURAL DISASTERS**

Natural disasters include earthquakes, landslides, rock falls, floods, storms, avalanche, lightening, cloud burst etc. Risk Analysis due to Natural Hazards are discussed in section 7.3.3.1 of this chapter.

#### **HUMAN -CAUSED OCCURRENCES**

Man-made occurrences include:

- Fire
- Electrical faults
- Technical faults like rope with broken wires in service, drive / return sheave shaft failure / tension system failure, mount assembly parts failure, over speeding of ropeway / brake

failure, rollback, slippage / fall of cabin, entanglement of cabin, swinging of cabin resulting in falling of cabin, cabin derailment at station etc.

Hazard analysis for the Natural & Man-made Disasters is discussed in the Table 7-1

**TABLE ERROR! NO TEXT OF SPECIFIED STYLE IN DOCUMENT.-1HAZARD ANALYSIS**

<b>Hazards</b>	<b>Severity (1-5)</b>	<b>likelihood (1-5)</b>	<b>Severity x likelihood (1-25) (Hazards scoring 1-12 are less serious hazards &amp; 13-25 are very serious hazards &amp; need prior attention)</b>
<b>Natural hazard</b>			
Earthquake	5	2	10
Landslides	5	4	20
Flood	2	2	4
Wind & cyclone	2	2	4
Cloud Burst	3	1	3
<b>Man-made hazard</b>			
Fire & explosion	5	2	10
Electrical	3	5	15
Technical/ Accident	4	3	20
Security	3	1	3

### 1.1.2 Vulnerability Analysis

As per the hazards analysis given in Table 7-1, the vulnerable areas during construction phase are mainly the immediate areas under construction.

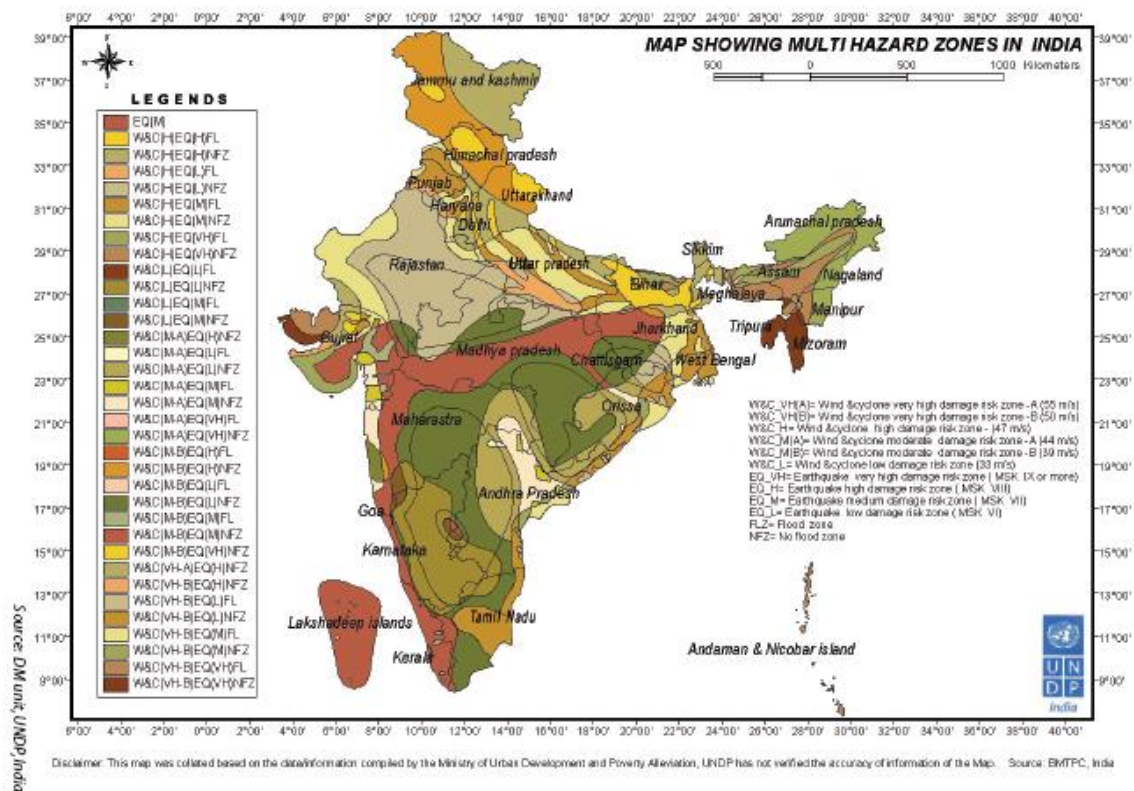
The vulnerability analysis during operation phase is given for natural as well as man-made hazards are shown in Table 7-2 & table 7-3 respectively.

**TABLE ERROR! NO TEXT OF SPECIFIED STYLE IN DOCUMENT.-2VULNERABLE LOCATIONS/ AREAS FOR NATURAL HAZARDS**

<b>Hazard</b>	<b>Vulnerability</b>
Earthquake	Damage to Towers, trolleys
Landslides	Damage to Towers.
Wind & cyclone	There are very moderate chances of wind & cyclone; this can cause damage to cable car.
Cloud Burst	Cloud burst can cause soil erosion, landslides and flooding on project site. It can cause damage to towers.

**TABLE ERROR! NO TEXT OF SPECIFIED STYLE IN DOCUMENT.-3VULNERABLE LOCATIONS OF DIFFERENT MAN-MADE HAZARDS**

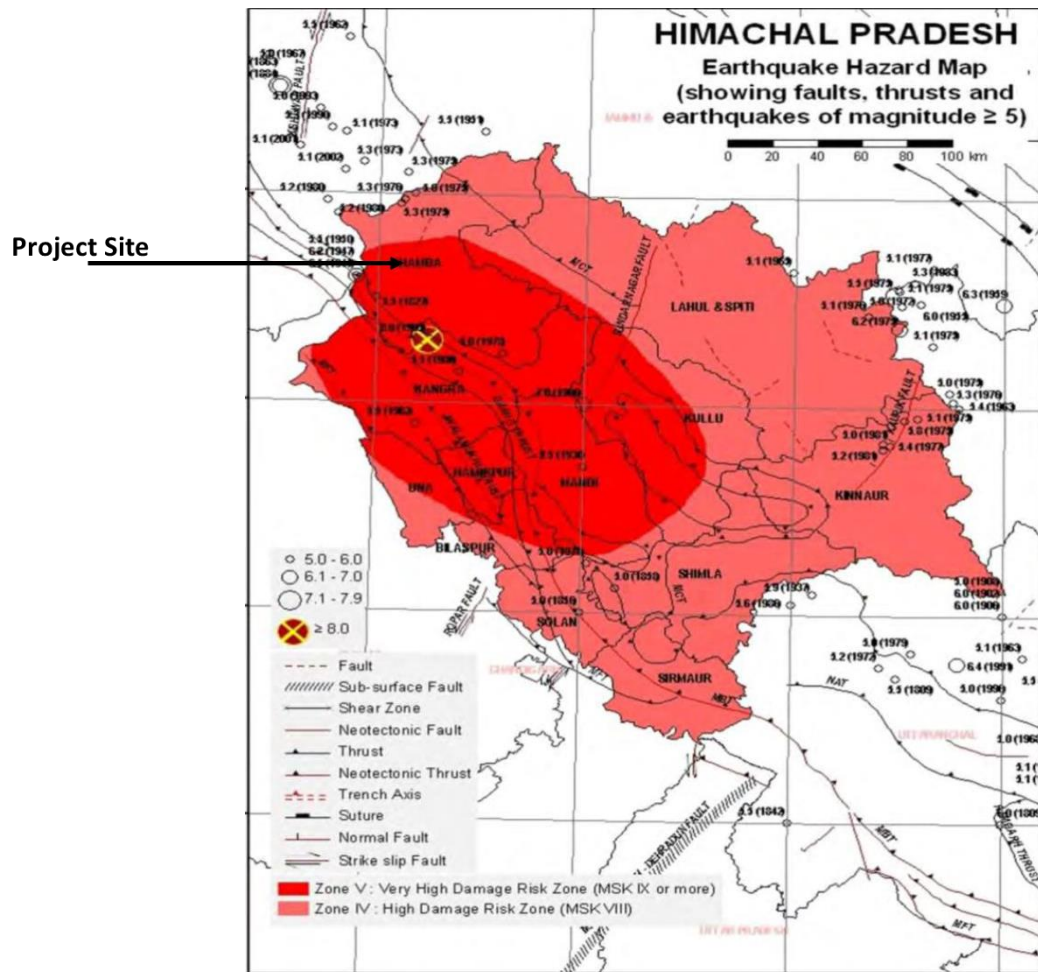
<b>Hazard</b>	<b>Vulnerable Locations</b>
Fire	Trolleys, Terminal Stations, Control Room
Mechanical/ Accident	Trolleys, Ropes, Terminal Stations, Ropeway Towers



### **7.1.1 Seismicity**

As per fig. 7- 2, the project site is located in chamba district which falls in seismic zone V which indicates very high damage risk zone.

FIGURE 2 SEISMIC MAP OF (SOURCE: NDRRP)



### 7.1.2 Landslides

According to geological, topographical and climatic conditions of the area and human factors such as deforestation, unscientific road construction (blasting carried out for road cuttings), constructions of dams or reservoirs, housing schemes, roads, terracing and water intensive agricultural practices on steep slopes etc., implemented without proper environmental impact assessments have increased the intensity and frequency of landslides.

The landslide vulnerability in case of Chamba, is high. Landslides may occur at the project site, if, slope stability is not maintained.

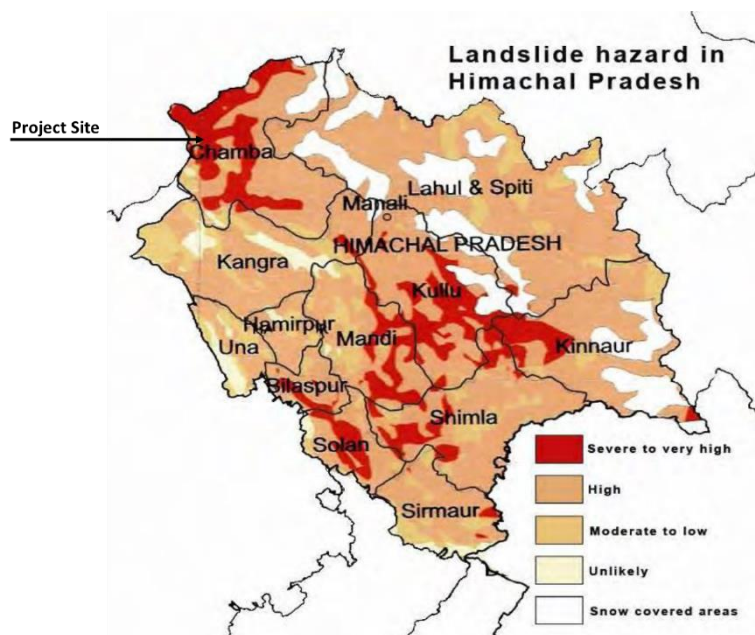
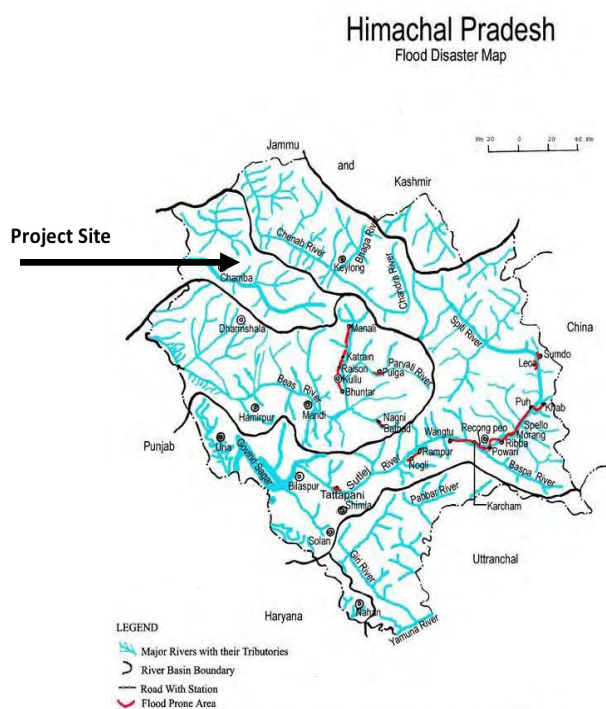


FIGURE 3 LANDSLIDES MAP (SOURCE-NIDM)

### 7.1.3 Flooding

The Chamba district falls in high vulnerable districts. More particularly the flash flood hazard incidences are increasing causing large scale damage.

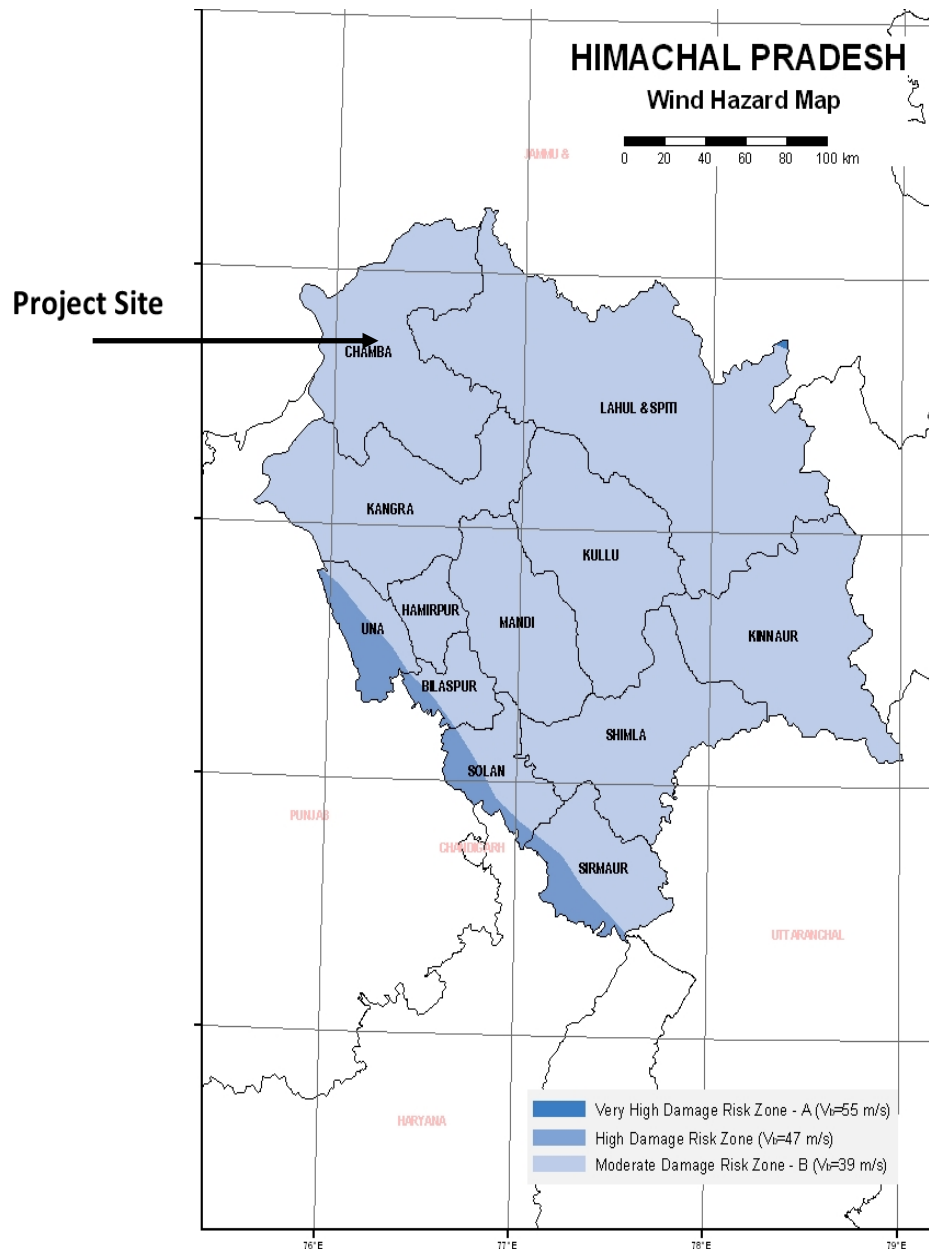
FIGURE 4: FLOOD MAP OF UTTARAKHAND



### 7.1.4 Wind & Cyclone

The temperature variation and wind speed are directly proportional to avalanches. It is evident from the map below that the project is a moderate risk.

FIGURE 6 WIND HAZARD MAP (SOURCE- SDMA)





### **7.1.5 Cloud Burst**

Though not a regular phenomenon, cloudbursts lead to exceptionally heavy rainfall and sudden flash floods in the mountainous streams and rivers, leading to breaching of banks and overflowing of dams.

#### **1.1.3.2 Human Induced Risks and Hazards**

### **7.1.6 Fire & Explosion:**

Since it is a ropeway project, fire can mainly cause due to electric spark in electrical room, fire in the surrounding forest area, fire in fuel storage places, etc. The Fire & explosion can cause loss to material of construction.

### **7.1.7 Technical Failures/ Accident:**

As the ropeway consists of cable cars, ropes & big & heavy machineries, technical failures as discussed in Section 7.1.1 can cause risks to people working in the area during construction phase & operation phase.

Consequences of the discussed hazards may result into accident.

## **1.2 PREVENTIVE MEASURES**

### **1.2.1 Natural Occurrences**

#### **1.2.1.1 Earthquake:**

The project will be situated in Seismic Zone-V area. Special attention shall be given to the structural design of foundation, elements of masonry, timber, plain concrete, reinforced concrete, pre-stressed concrete, and structural steel. All applicable guidelines will also be followed in this regard to ensure safety of the building.

#### **1.2.1.2 Landslides:**

The area where ropeway is proposed is highly prone to landslides. Structural stability & safety is must to prevent ropeway damage due to landslides. Slope stability in the area shall be maintained at 45°.

#### **1.2.1.3 Flooding:**

- Although the site is not prone to flooding & being at the highest peak, the probability of flooding is very less, proper designing of drainage system shall be done.
- All the waste water shall be disposed off to soak pits.



- Structures shall be built in such a way that no harm occurs to the people & structures due to flooding due to natural calamities.

### 1.2.2 Man-made Occurrences

#### 1.2.2.1 Fire and Life Safety:

- Smoking must be prohibited.
- Electrical equipment must be explosion-proof to meet national electrical code requirements.
- Dry chemical extinguishers should be accessible for small fires. An adequate supply of handheld and wheeled types should be available.
- Hydrants should be strategically placed with adequate hoses.
- Small spills should be remediated with sand, earth, or other non-combustible absorbent material, and the area then flushed with water.

#### 1.2.2.2 Technical Faults & Accidents

- Bucket carrying material shall be provided with 2 nos. detachable rope grips.
- The ropeway system will be provided with minimum of two braking systems (Normal, Emergency and Service Brake). The emergency shall be hydraulically operated brake provided on braking track of drive sheave. The service brake shall be electromagnetic brake provided on high speed brake disc.
- In event of main power supply failure, the system should have full rated Diesel Generator to supply power to run drive motors.
- Standby separate motor system will be provided for each station to run ropeway at slow speed in case of failure of main motor or power failure of DG set.
- Line safety devices should be installed on each trestle, holds down & pressure frames which immediately stop the ropeway in the unlikely event of rope derailment. This should comprise of electrical trip limit switch with attachment mounted on line sheave mount. In an accidental case, if the hauling rope comes out of line sheaves it should be automatically trip the ropeway by the actuation of limit switch through the attachment.
- Rope catcher will be provided on mount beams on line trestle, P.F. and Stations to arrest/support the hauling rope in case of de-ropement.
- Emergency push buttons will be provided at stations to stop the ropeway, if required.
- The ropeway main drive motors to be tripped if:
  - Set rope speed exceed by 5 %

- Wind speed exceeds the limit 150 km/hr as per Indian Standard so that damage to the rope and bucket due to the vibration caused can be prevented.
- The project shall be provided with anemometers to monitor the wind speed and to provide trip signals to main drive in case wind speed exceeds a pre-determined set speed.
- Each station will have a first-aid medical facility.

### 1.3 MAINTENANCE & MANAGEMENT OF ROPEWAY

#### 1.3.1 Maintenance Record

The ropeway operator will ensure that:

- Written procedures are developed for operating the equipment under all reasonably foreseeable conditions, and that all safety requirements are incorporated into these procedures.
- Records are kept of every critical safety stage in the operation of ropeway.
- Operating procedures and all other relevant operating records are freely available to any person who operates the equipment.
- All operational data are available for inspection by any authorised person who is involved with the ropeway, including equipment inspectors.

#### 1.3.2 Daily Operational Requirements

**Starting of ropeway:** The ropeway will be start by the competent person authorised by the management.

**Daily inspections:** Prior to transporting material, a daily inspection will be conducted by competent personal. As a minimum, the inspection will consist of the following:

- Inspect visually each terminal, station, and the entire length of the ropeway, including grips, hangers and carriers:
- Note the position of tension trolley and ensure that tensioning system is free to move in both directions.
- Test the operation of all manual and automatic switches in terminals, stations, and loading and unloading areas, as per the manufacturer's specifications.
- Test the operation of main drive and all braking systems.
- Test the operation of communication systems.
- Note the general condition of the hauling rope.

### 1.3.3 Operation Log

- A daily operational log shall be maintained for ropeway.
- The daily operational log shall include at least the following:
  - a) Date;
  - b) Names and duty stations of operating personnel;
  - c) Operating hours and purpose of operations;
  - d) Temperature, wind, and weather conditions and changes, with times of changes noted;
  - e) Record of compliance with daily operational inspection;
  - f) Position and condition of the tensioning carriage and of the counterweight or other tensioning devices;
  - g) Accidents, malfunctions, or abnormal occurrences during operation; and
  - h) Signature of the operator.

### 1.3.4 Maintenance of Ropeway

The maintenance program will comprise of procedures for addressing all components subject to load, wear, corrosion or fatigue. This would include:

- The types of lubricants required and frequency of application;
- The types of testing required and frequency of testing;
- The definitions and measurements to determine excessive wear and replacement criteria.
- The recommended frequency of service to specific parts and details of the service required.
- Identification of other areas that might require specific attention.

### 1.3.5 Ropeway Management

**The ropeway management shall ensure that:**

- The ropeway including all safety devices is maintained in accordance with the maintenance and inspection schedules and are kept in safe working condition at all times.
- A procedure is in place which requires any faults found in the ropeway to be reported immediately by the person who finds the fault, investigated and, where necessary, maintained, adjusted, repaired or altered.
- Ropeway that has been subject to maintenance, whether routine maintenance or maintenance in response to a fault found, shall be appropriately tested before re-

entering service, to ensure their design compliance.

- All maintenance procedures relating to the ropeway shall be kept in controlled status regularly updated and continually improved and shall be executed by competent persons.
- Proper inventory of spare parts shall be maintained in a proper storage area.

**The operator of the ropeway will ensure that:**

- The date, time and full details of any maintenance work undertaken and the results of any maintenance procedure carried out.
- Ensure that maintenance records are available for examination by all persons concerned, including equipment inspectors.
- Keep record of running hours and/or number of loading cycles operated by a ropeway and its condition, where a material ropeway, or any of its components, is subject to condition monitoring.

#### 1.3.6 Inspection of Ropeway

The owner /operator of the ropeway shall ensure that:

- Commissioning inspection has been carried out by an equipment inspector, who shall also witness all relevant tests.
- Formal pre-season inspections are carried out
- The ropeway is inspected in-service at least annually for issue of certificate of inspection.
- Daily and periodic maintenance inspections are carried out.

**Records:** A list of parts to be inspected will be maintained. The operator of the ropeway will maintain records of the date, time, time and results of any inspection carried out and the name of the inspection body engaged.

#### 1.3.7 Tests of Ropeway Operation

The ropeway operator will ensure that:

- All routine tests of emergency procedures, and of alarms, and safety devices, relating to the ropeway, are carried out at appropriate intervals.
- Every overload test is carried out under strict conditions, is monitored at all times and does not exceed the limits specified in the relevant design or operating standard;

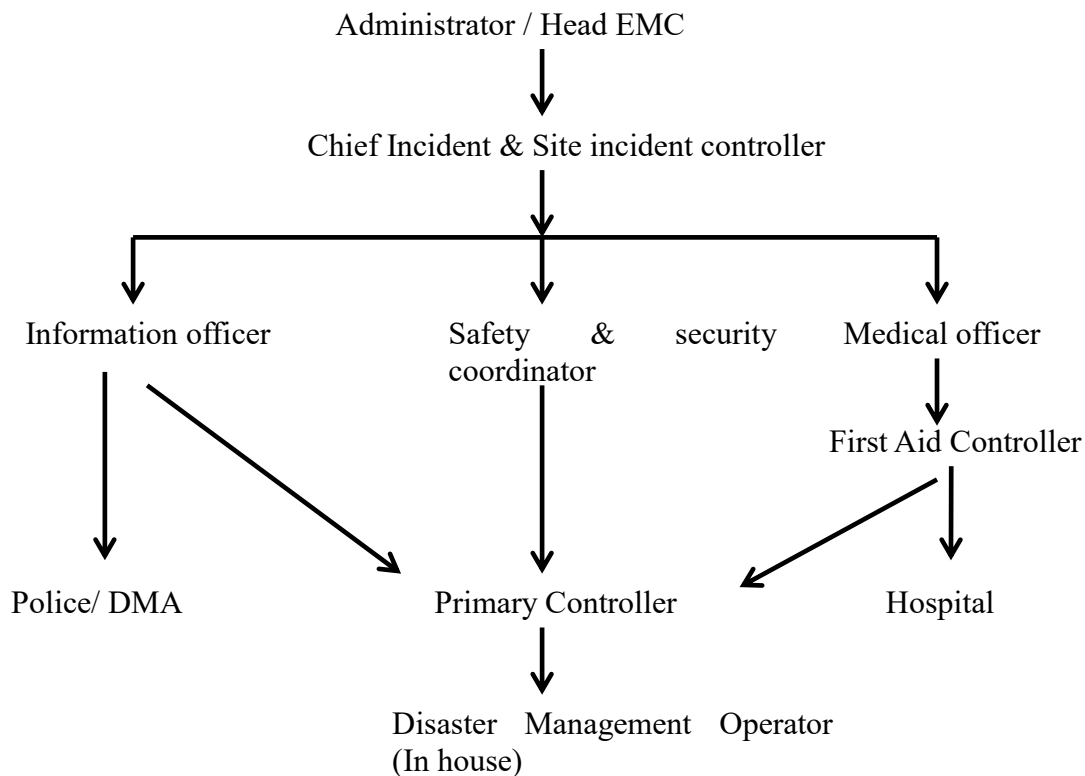
- The ropeway is not loaded above its safe working load, except for the purposes of an overload test.

**The records of the following will be maintained:**

- The date, time, details and results of any tests carried out are recorded.
- Comments on the performance of ropeway in any test, and on any maintenance done or any adjustment, alteration, or repair made as a result of any test are recorded; and
- Any data arising from testing are readily available for inspection by authorised persons including equipment inspectors.

The Emergency Management Cell teams outline is given in figure 7-6:

**FIGURE 7 EMERGENCY MANAGEMENT CELL TEAMS OUTLINE**



#### 1.4 SPECIFIC SAFETY FEATURES FOR A ROPEWAY

There are numerous redundancies and secondary systems designed and built into the construction and aerial ropeway technologies to ensure reliability and safety. Specific safety features for a ropeway include:

- Back-up Generators – In the event of a primary engine failure, secondary diesel generators are typically available to continue operation.

- Secondary Bearing System – The main bull wheels in each terminal may have a secondary set of bearings in the event of primary bearing failure.
- Tire Conveyor Redundancy – Both the accelerator and decelerator conveyors have secondary lines with separate power in the event of a primary failure.
- Recovery concept -If secondary power fails and on-line rescue is required, comprehensive evacuation guidelines are implemented and carried out by specially trained personnel. The form of the evacuation depends on lift type and site conditions.
- In order to enhance system reliability, besides the electric main drive unit (AC motor), two independent hydrostatic emergency drive units allow for operation of the system at a reduced capacity and in emergency cases for each section.
- The hydraulic emergency drive can be installed to bring the bucket zback to the station.
- The detachable system features friction sheaves at the incoming and outgoing sides of the stations. These sheaves transmit the speed of the rope via double V-belts to the conveyors which transport the carriers through the stations. This configuration ensures positive control and synchronization of rope speed and carrier conveying speed in each station in both forward and reverse directions, irrespective of the drive selected.
- Key functions of the ropeway, such as rope speed and grip opening and closing operations, are monitored and controlled by electronic safety circuits in order to ensure smooth operation and maximum safety. Fixed rope tensioning is achieved by two hydraulic cylinders in the tensioning terminal for each rope loop.
- Two separate brakes will be provided in the drive of ropeway system.
- In the event of main power failure, full capacity standby D.G. set will be provided to supply power to run drive motor.
- Standby separate motor system/rescue engine will be provided to run ropeway at slow speed to bring bucket back from line in case of failure of main motor or power failure from DG set.
- Rope catcher will be provided with the fully articulated sheave mount beam at incoming and outgoing side on line trestles and Stations to arrest / support the hauling rope in case of de-rope ment.
- Emergency push buttons will be provided at all stations to stop the ropeway, if required.

- Both the stations and line safety devices will also be operative during running the ropeway with separate motor at a maximum speed of 1 m/ sec. Battery back should also be provided for opening of service and emergency brakes.
- Control Panels and Distribution Boards will be provided at all stations for operation as well as maintenance purposes. Control relays and interlocks will be provided for rescue Drive, emergency motor and brake operation. A.C. drive will be provided with forward reverse operation, speed variation (auto and manual) and inching facilities.
- Line safety devices are installed on each trestle, which immediately stop the ropeway in the unlikely event of rope derailment. This comprises of electrical Ceramic fuses with attachment mounted on line sheave mount.
- Set rope speed exceeds by 5%
- Wind speed exceeds the set limit.

All elements of the ropeway are mounted onto a steel structure which is anchored on concrete foundations.

## **1.5 SAFETY MEASURES FOR WILDLIFE**

From the safety point of view, the aerial ropeway seems to offer no danger of any kind to the Wild Life. However, all precautions and safety measures will be taken to ensure Maximum Safety of the any type of Wild life at site during construction as well as Operational Phase, which are discussed as under:

### **1.5.1 During construction phase**

- Night time construction activities will not be allowed in order to minimize the human-animal conflict.
- Storage Yards for Construction Material, Tower Erection Steel Structures, Cable storage areas and other related Storage and working areas shall be properly made.
- The storage yards and construction areas will be barricaded with meshed wire fence of at least 3 m height. This would prevent the wild animals from accidentally entering into these work areas during the construction phase and thus ensure their safety.

### **1.5.2 During Operational Phase**

- Minimum required area is being considered for the construction of Terminal Stations.
- As the Ropeway Towers, which shall be made up of steel, are to be erected over the ground, the base of the towers shall be of some danger to the Wild Life. Thus, they would be closed



in a mesh wire enclosure which shall be approximately 6 feet (2 m) high. This would prevent any animals from straying into these steel girder bases of the towers.