

7.2 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:

- 7.1.1 Hazard Identification
- 7.1.2 Vulnerability Analysis
- 7.1.3 Risk Analysis
- 7.1.4 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.

7.2.1 Hazard Identification

Aerial ropeway at Radha Rani will 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, lightning etc. Risk Analysis due to Natural Hazards are discussed in section 7.1.3 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 fall of passengers outside cabin, cabin derailment at station etc.

- *Security threat*

Hazard analysis for the Natural & Man-made Disasters is discussed in the Table 8-1

TABLE 7-1HAZARD ANALYSIS

Hazards	Severity (1-5)	likelihood (1-5)	Severity x likelihood (1-25) (Hazards scoring 1-12 are less serious hazards & 13-25 are very serious hazards & need prior attention)
Natural hazard			
Earthquake	5	2	10
Landslides	5	2	10
Flood	2	1	2
Cloud Burst	4	2	8
Wind & cyclone	5	2	10
Man-made hazard			
Fire & explosion	5	2	10
Electrical	3	5	15
Technical/ Accident	4	5	20
Security	4	1	4

7.2.2 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 7-2 VULNERABLE LOCATIONS/ AREAS FOR NATURAL HAZARDS

Hazard	Vulnerability
Earthquake	Damage to Towers, Terminal Stations, Cable Cars
Landslides	Damage to Towers if slope stability is not maintained.
Flooding	River Yamuna (due to cloud burst or excess rain)
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 and terminal Stations

TABLE 7-3 VULNERABLE LOCATIONS OF DIFFERENT MAN-MADE HAZARDS

Hazard	Vulnerable Locations
Fire	Cable car, Terminal Stations, Control Room
Electrical	Cable Car, Transformer, Control room
Mechanical/ Accident	Cable car, Ropes, Terminal Stations, Ropeway Towers
Technical	Ropeway, Cable car, Terminal Stations
Security	Terminal Stations, Parking, Population at site

7.2.3 Risk Analysis

Environmentally Induced Risks and Hazards

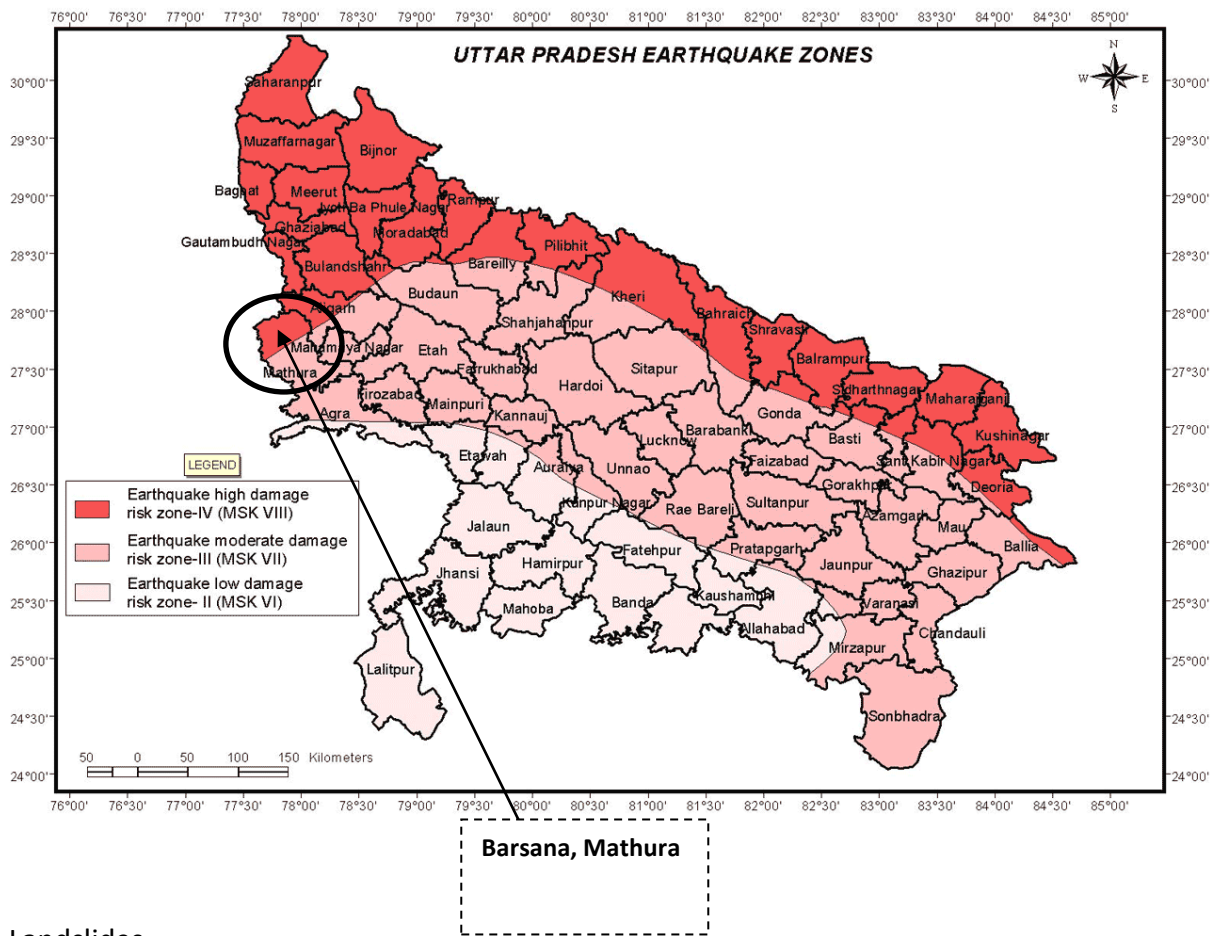
Natural Calamity Hazard Profile

Hazard profile map of India (published by Home Ministry of India as a part of document 'Disaster Management Plan in India') is depicted in figure 7-1.

The region having project site is prone to following Hazards:

- Earthquake
- Landslides
- Flooding
- Wind & Cyclone
- Cloud Burst

FIGURE 7-2 SEISMIC MAP OF UTTAR PRADESH



Landslides

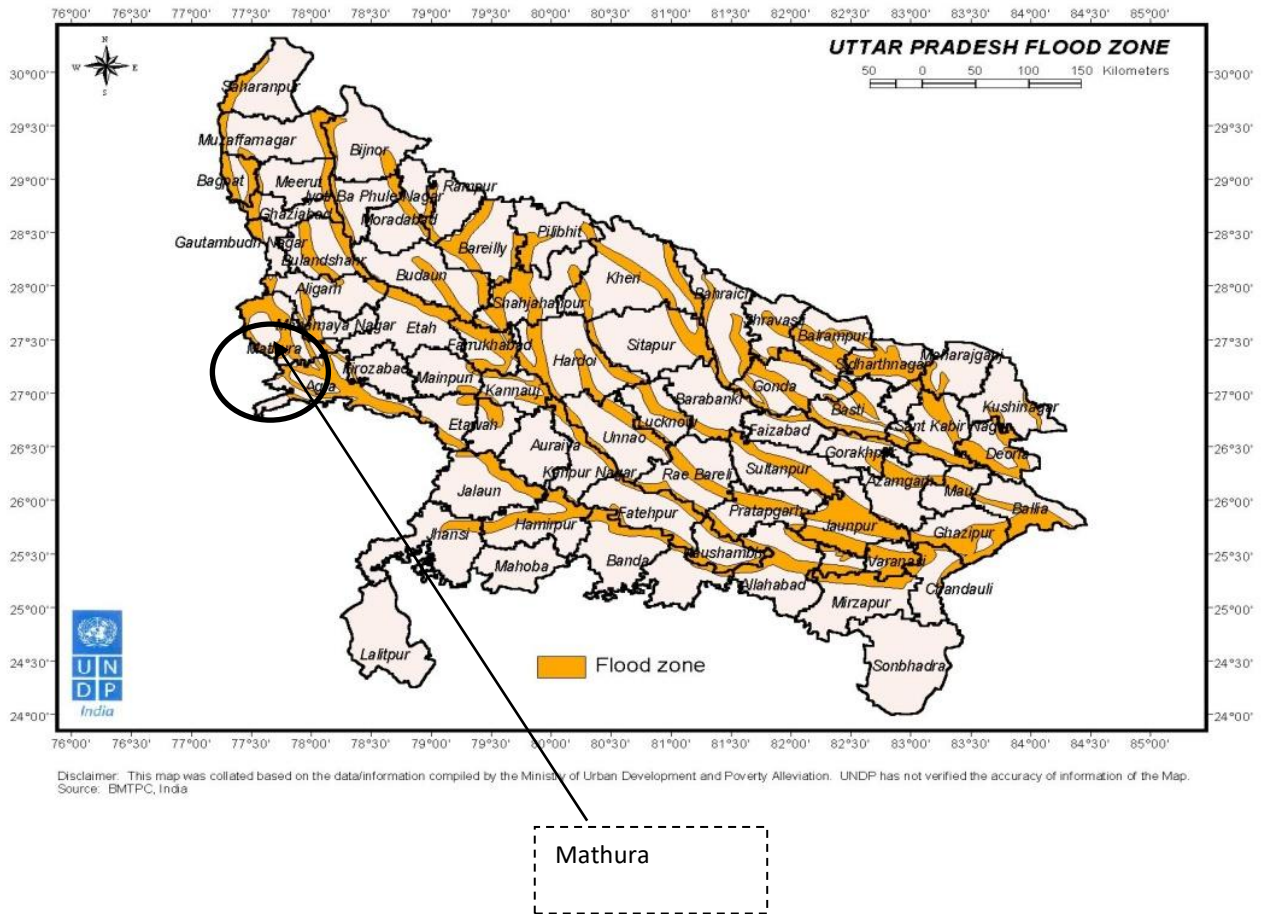
According to geological, topographical and climatic conditions of the area and human factors such as deforestation, unscientific road construction (blasting carried out for road cuttings), constructions of dams or reservoirs, housing schemes, roads, terracing and water intensive agricultural practices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

Landslides may occur at the project site, if, slope stability is not maintained.

Flooding

The project does not fall under flood risk area

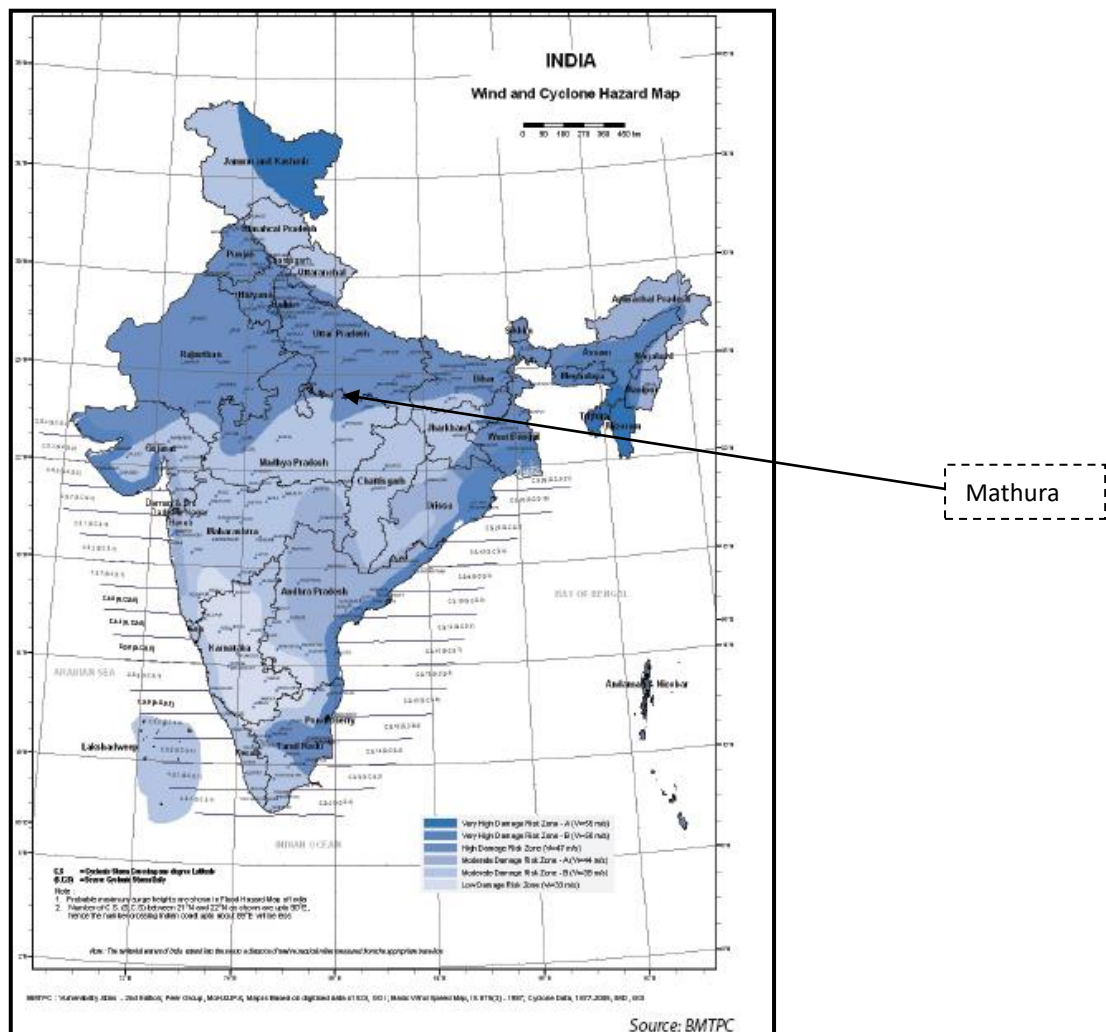
FIGURE 7-3 FLOOD MAP OF UTTAR PRADESH



Wind & Cyclone

The yearly distribution of tropical cyclones in the north Indian Ocean indicates large year to-year variations in the frequency of cyclonic disturbances and tropical cyclones, but no distinct periodicity. However, the trend indicates a slight decrease with time. The Cyclone hazard map of India as depicted in the Figure 7-4, gives the vulnerability map of hazard due to cyclone. As per this map, the project area falls under a zone where high wind & cyclone is seen.

Figure 7-4 wind & cyclone map of India



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.

Human Induced Risks and Hazards

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 suffocation due to harmful gases generation & panic among people.

Electrical:

The ropeway will run on electricity & hence electrical current can pass through cable cars & wires due to inadequate insulation or accidentally.

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 & people who will travel through the ropeway in operation phase.

Consequences of the discussed hazards may result into accident.

Security Threat:

War, crisis & terrorists can cause panic among public and staff.

Emergency Plans

Classification of Emergencies

Level of emergency should be declared as per criteria given hereunder:

➤ **Level 1 Emergency**

- No immediate danger to public or environment;
- Incident is confined to the lease or company property;
- Low potential for situation to escalate;
- Handled by company personnel; etc.

➤ **Level 2 Emergency**

- Potential for risk to the public/environment; the emergency could extend beyond company property;
- Control of incident is still possible;
- May require the involvement of external emergency services, federal, provincial or local agencies; etc.

➤ **Level 3 Emergency**

- There exists an immediate danger to the public or environment;

- Control of the situation has been lost;
- Extensive involvement of external emergency services, federal and/or provincial agencies;
- Emergency extends beyond company property;

Proposed ropeway shall involve Level-1 and Level-2 emergencies. However, in case of natural calamity such as earth quake, it may have Level-3 emergency.

A definite plan will be made for marshalling passengers for safe loading and unloading. The ropeway manager will establish and draw up any special instructions necessary to be observed by staff to ensure the safety of children and elderly persons riding the ropeway and shall ensure that such instructions are implemented and enforced by the staff.

Loading attendants are to ensure that passengers do not embark on chairs, or in cars or cabins, with equipment which will in any way be a hazard to the safety of themselves or other passengers.

Communication

Both an audible signal system and a two-way voice communication system shall be maintained between the drive station and all loading and unloading stations. If only one system fails to operate, the ropeway may continue to run, provided the remote attendant stop system is fully operational. In the event of the failure of both communication systems, the ropeway shall not be operated. In the latter event, provided that adequate special precautions are taken, the ropeway may be run for the purpose of evacuation only.

No ropeway shall be operated without a functioning dedicated communication system.

Disaster management

1. Establish direct contact with district administration and District Disaster Management Authority (DDMA) for any update on forecast (warning);
 - Follow up agencies for forecast and keep records;
 - Indian Metrological Department for cyclone and earthquake;
 - Central water commission for flood forecast;
2. Establish an in-house rescue team of volunteers from each unit and impart training as per DDMA;

3. Establish a first aid team of volunteers from each unit and impart training as per DDMA;
 4. Organize mock drills in association with DDMA;
 5. Establishment of Central Control Room for communication with Government agencies;
 6. Updated contact details should be kept for the following:
 - District Magistrate
 - District Police Administration
 - DDMA
 - District Fire Service
 - District Hospital
 - District electricity Supply Agency
 - District Water Supply Agency
 7. Development of Standard Operating Procedures for role and responsibility of individual of response team.
 8. Warning System
 9. Inspection of design of buildings and towers with respect to severity of hazards presents;
 10. Removal of encroachments and keeping basic infrastructure like roads, power & water supply, waste and storm water drainage system, parking etc. in healthy conditions;
 11. Demarcation of assembly points and evacuation routes for workers and general public in case of emergency;
 12. Keep records of chemical inventorization and associated hazards with each unit;
 13. Planning for risk reduction measures due to chemical storage and traffic parking & movements;
 14. Assessment of impacts and design & implementation of remedial measures; etc.
- An Emergency Management Cell will be developed, which is discussed in Section 7.6.

7.3 Preventive Measures

Natural Occurrences

Earthquake:

The project will be situated in Seismic zone-IV 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.

Landslides:

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

Flooding:

- Although the site is not prone to flooding & being at the highest peak & away from rivers, the probability of flooding is very less, proper designing of drainage system shall be done.
- All the waste water shall be disposed off to Septic Tank followed by Soak Pit.
- Structures shall be built in such a way that no harm occurs to the people & structures due to flooding due to natural calamities.

Man-made Occurrences

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.

Technical Faults & Accidents

- The carriages will be provided with door lock which cannot be opened by the passengers.
- Carriage of each cabin shall be provided with 2 nos. detachable rope grips.

- The ropeway system will be provided with minimum of two braking systems- Normal/ Emergency Brake and Service Brake. The emergency brake shall be weight operated & thruster released brake which should be provided on brake ring fitted on drive sheave. The service brake shall be weight operator thruster released brake shall be provided on high speed brake drum coupling.
- In event of main power supply failure, the system should have full rated Diesel Generator to supply power to run drive motors.
- Standby diesel engine should be provided for each station to run ropeway at slow speed to rescue passengers from line in case of failure of main DC motor.
- 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 set limit
- 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.

7.4 Maintenance & Management of Ropeway

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.

Daily Operational Requirements

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

Daily inspections: Prior to transporting passengers, 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 carriages and counterweights and ensure that the 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.

Termination of Daily Operations: Procedures will be established for terminating daily operations to ensure that passengers shall not be left on the ropeway after it has been shut down.

Operation Log

- A daily operational log shall be maintained for each 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.

Maintenance of Ropeway

Detailed operation and maintenance instruction manuals covering all aspects of maintenance of the Ropeway System would form an integral part of system documentation.

The essential aspects of maintenance are, however, briefly listed below:

- cabins, hangers and grips etc shall be done.
- Periodic lubrication at the Stations shall be done.
- Routine lubrication at the Stations.
- Regular cleaning at stations to ensure a clean and dust-free atmosphere.
- Periodic Inspection, checking and replacement of hauling rope especially the spliced zones.
- Inspection, checking, lubrication and replacement if and when required of line components such as line sheaves.
- Tightening of all station tower bolts periodically.
- Checking of prime mover such as motors, gearbox, couplings etc.
- Regular checking of service and emergency brakes.
- Regular checking of DG set and Diesel Engine.
- Mock trial of rescue system at periodic intervals.
- Adequate maintenance spares will be stocked for smooth operation.

Special tools & tackles will have kept in the workshop.

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.

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 passenger ropeway and its condition, where a passenger ropeway, or any of its components, is subject to condition monitoring.

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 preseason 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.

Inspection Intervals: The operator will ensure that the ropeway is inspected in-service and is:

- Inspected at commissioning, after the first year of service and thereafter at least once in a year.
- Inspected after their re-erection or re-commissioning;
- Inspected after major repairs or alterations; and
- Inspected in the event that they are seriously damaged.

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.

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; and
- 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.

7.5 Security Threat Plan and Action Plan to Meet the Eventualities

ISO 27001 and 27002, which are the international best practice information security management standards, defining and guiding Information Security Management System (ISMS) development shall be adopted. These will provide the necessary benchmarking for individual users to know the type of cover and the responsibilities that are defined and provided by that institution for its guests. Most importantly, training, to staff needs to be regularly imparted in dealing with such situations.

A four-tier security plan will be designed for the project:

Tier I Securing Building Externally and its periphery

Tier II Security of Building from Internal Threats

Tier III Provision of:

- a. proper Surveillance System
- b. Training and Security Drills (including Contingency plans)
- c. Security of Infrastructure Support Service System
- d. Making of Standard Operating Procedures

Tier IV Emergency Response Team

Description of the Tiers:

Tier 1 Protection against attack from Sky

1. There can be a threat from Microlite suicide squads.
2. In case Terrorists are launched through Helicopters, then Mobile quick reaction team to move on terrace of stations with suitable arms and ammunitions which will be backed by reaction team.
3. Coordination of Security Control Room with Army Defense system through Central Control System of the city/Army/Air Force.

Tier II Securing Building Externally and its periphery

1. **Manual Checks:** At all terminals, the visitors shall be manually checked and asked for ID's.
2. **CCTV:** At all important location with a remote viewing facility and record back up. With highest resolution and picture quality. DVR being the back bone, its recording and replaying capabilities must be considered.
3. **X-Ray Scanners:** This may be installed and the bell desk may ensure that all the baggage's while being shifted out or in goes through the machines. One scanner shall be installed at terminal stations entry.
4. **RFID** based access control and smart card applications can also control the movements of guest as well as staff.
5. **Zoning System:** Apart from this equipment there are agencies providing Zoning system. This system would be integrated with the BMS and in the event of terrorists strike it automatically will close the fire exit door and stairs door thus limiting the movement of the terrorist in one place.

Tier III Security of Building from Internal Threats

1. **Staff Profiling:** All the staff shall be required after proper verification of identity and residential proof. Smart card identification shall be given.

2. **Metal Detectors:** Every visitor will walk through metal detectors. There will be one metal detector at staff entry gate.
3. **Bomb Blankets:** This will reduce the impact of an explosion.
4. **Central Control Room:** This will control the security system from inside.
5. **Safety of weapons:** The weapons shall be kept in security.
6. **Communication Systems:** Proper communication system to security staff shall help them to coordinate better during emergencies.

Tier IV Provision of:

a. Proper Surveillance System

1. **Bio – Metric Access:** All the electronic locks be replaced as bio matrix access control in the rooms. It is suitable way to have finger prints in the name of a high-end technology.
2. **Wireless Mobile Devices:** These can be installed at various locations to intercept people communications.
3. **Glass protection System:** This is a unique product combination of high security laminate films with chemicals which makes it blast resistant and thus protecting human life's and property from the damage caused by splinters.
4. **Explosive detectors:** With the help of this detector, the security personnel can check various zones for traces of explosive.

b. Training and Security Drills (including Surveillance System)

Disaster planning is the responsibility of all sections of the community. The police, fire brigade, civil defence, Home Guards, press, clergy, industrial groups, and community groups must participate in the pre-disaster planning. The community as a whole has the responsibility to teach first aid to groups in the community that could be utilized in disaster situations. The disaster may involve the normal communication network itself. Therefore, two-way radio systems and messenger systems must be included as backups in the event of a communication-system failure.

Proper training, security drill and evacuation drill shall be conducted in a defined time period, so as to train the management people, security personnel's, senior staff and all

other working staff to take control of all odds what so ever come in the way. These trainings shall be conducted for use of weapons and Arms by some trained agencies for the said trainings. The training shall be done periodically.

c. Security of Infrastructure Support Service System

1. Hourly checking of building including Toilets and dust bins.
2. Random checking of visitors
3. Installation and Precautions of Public Addressing system.
4. Preventive measures for attack on D.G. Sets, Water Treatment System, Water Storages, Ventilation System.
7. Security against Chemical War & Anti hacking devices

d. Making of Standard Operating Procedures

A standard operating procedure manual shall be prepared, followed and maintained for all the eventualities due to attack by armed intruders.

Tier V Emergency Response Team

An emergency response team shall be formed.

7.6 Rescue Arrangement:

The Ropeway system would be provided with a rescue arrangement to enable the passengers being evacuated in case of an extreme emergency where cabins are stopped on line.

- *Ladder rescue* can generally be adopted for cabins which are stranded close to the ground. Here a light but strong aluminium ladder with a hook at the top is placed in position next to the cabin. An attendant stabilizes the ladder from below while another attendant goes up to open the door and help the passengers to come down.
- *Rope Rescue System* involves a winch and lowering rope. A small hand winch is clamped to the nearest tower, uphill from the stranded cabin. One attendant climbs the tower and then he “rolls” down to the cabin by means of a carriage which is restrained by a rope attached to the hand winch. Once the attendant reaches the cabin he views the restraining rope through a set of rollers pre-fitted to the cabin. A safety harness is now attached to the end of the rope and

individual passengers are lowered to the ground by means of the harness, rope and winch.

- *Diesel engine* with independent drive, so that the ropeway system can be operated at reduced speed to bring stranded cabins to the terminal stations in case of failure of electrical power supply or main motor. A full capacity DG set to continue normal operation in case of main power supply disruption.
- As mentioned elsewhere the *Auxiliary Drive* with diesel engine enables the passengers to be evacuated in the event of power failure.

7.7 Emergency Management Cell (Off-site Emergency Planning)

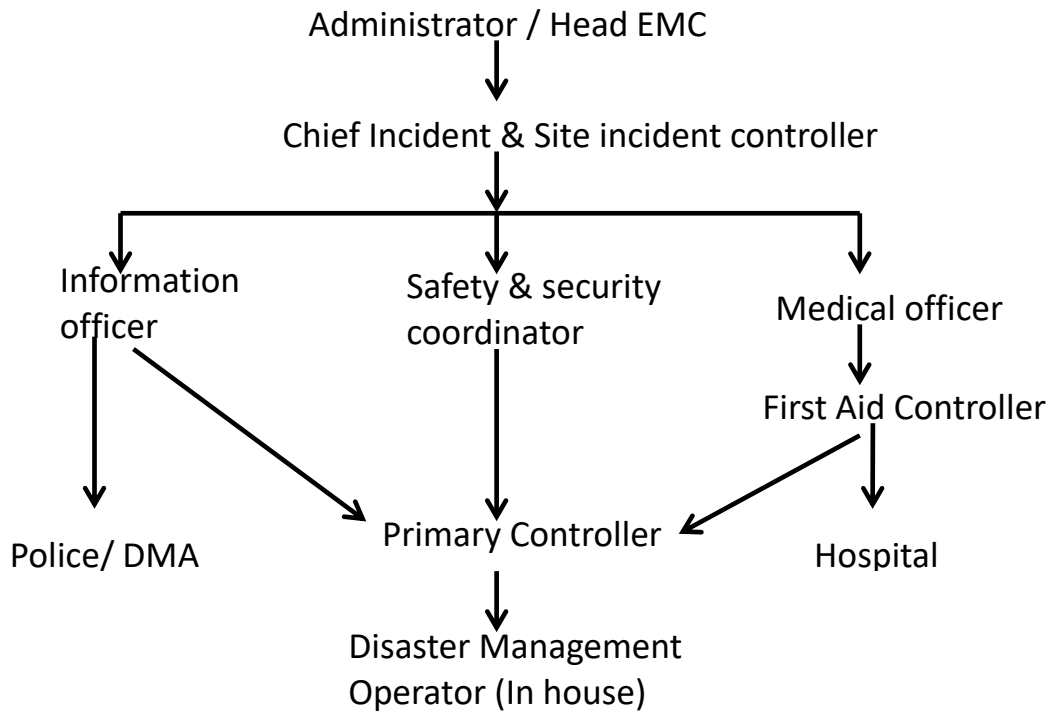
The actions necessary in an emergency depend upon the circumstances. It is imperative that required actions should be initiated and directed by a nominated team having specified responsibilities. An Emergency Management Cell will be formed, so that at the time of any Emergency, the team can work as a coordinator between all affected tourists and medical facilities/ requisite measures.

This avoids confusions arising out of panic situation. The details of proposed Incident Emergency Response Team are as per given hereunder:

1. Site Controller
2. Incident Controller
3. Safety & Security Coordinator
4. Information Officer
5. First aid coordinator
6. Medical Officer
7. Primary Controller

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

FIGURE 7-6 EMERGENCY MANAGEMENT CELL TEAMS OUTLINE



ROLE OF EXTERNAL AGENCIES DURING EMERGENCY

It is expected that the following roles shall be performed by various agencies:

Medical Facilities-Nearest Hospital – Government Hospital (0.62 Km SW)

Airport Facility- The nearest airports is Indra Gandhi International Airport (104.45 km NNW)

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:

During construction phase

- 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.

During Operational Phase

- Minimum required area is being considered for the construction of Terminal Stations at maximum ground coverage.
- 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.
- The main stations of the Ropeway housing the pulleys with moving parts shall also be secured for bird hits by enclosing them with bird meshes.