

## **7.10 RISK ASSESSMENT:**

### **7.10.1 Introduction:**

Risk assessment is a systematic method of identifying and analyzing the hazards associated with an activity and establishing a level of risk for each hazard. The hazards cannot be completely eliminated and thus there is a need to define and estimate an accident risk level possible to be presented either in quantitative or qualitative way. Risk assessments will help to prioritize risks and provide information on the probability of harm arising and severity of harm by understanding the hazard, combine assessments of probability and severity to produce an assessment of risk and it is used in the assessment of risk as an aid to decision making.

In recent years the concept has begun to achieve more acceptances within the ranks of water resources management. Application of risk analysis to dams raises a unique set of problems, because each dam is a unique system within its own distinctive environment. A spillway forms a part of the main dam system. While dam safety is a major concern, in the context of the present project, the risks involved during the construction of the spill way has been focussed here. Further the hazard may Natural Hazard or Manmade Hazard.

### **7.10.2 Environmental Risk Management:**

Most water resources projects, by and large designed with the environmental sustainability are not altogether free from Risks and hazards which may appear during the entire implementation period. Due importance is therefore attached to the review of environmental design considerations, identification of areas involving risks and hazards along with appropriate mitigative measures in the management plan. This approach proceeds from the conviction that the development objectives cannot be materialized fully unless disaster mitigation is built in to the development process.

#### **Risk Management:**

Risk as defined is the probability of harm or likelihood of harmful occurrence being released and its severity. An environmental hazard entails a set of circumstances which lead to the direct or indirect degradation of the environment and becomes a cause of damage to the life of people, property or environment.

#### **A. Assessment - Approach:**

- To identify the potentiality hazardous areas so that necessary safety measures can be adopted to minimize the probability of accidental events & failure of design.
- To identify the potential areas of environmental disasters, which can be prevented by proper design of installations and controlled operation.

#### **B. Management Procedure:**

- Set up a committee of experts to probe the cause of such events, estimate the probable losses and suggest remedial measures for implementation so that in future such events or similar events do not reappear.

## 7.10.3 Review of the Environmental Design Considerations:

Sl.	Design objectives	Reviews and accomplishments
1.	<ul style="list-style-type: none"> <li>• Should confirm to aesthetically satisfying structures as well as the landscape.</li> <li>• Should cause minimal disturbance to the ecology of the area.</li> </ul>	<ul style="list-style-type: none"> <li>• The proposed additional Spillway of Hirakud Dam will be located on the left bank dyke on the second saddle of the Gandhi Hillock with releasing arrangements through 5 gates each of size 15mX15 M. The physiography of the area comprises hills, valleys and plains-hills up to height of 278m being in the central part. The construction of spill way therefore will change the aesthetics. However, new landscape will develop which shall be aesthetically satisfying.</li> <li>• As the hills will be demolished for construction of Spillway the ecology will be disturbed.</li> </ul>
2	<p>Structural design considerations</p> <ul style="list-style-type: none"> <li>• Design of the structures should be safe from stability considerations.</li> <li>• Utilizable materials in the structure should not disturb the ecology.</li> <li>• Prevent excessive soil erosion during construction phase which may transport the sediment load to the downstream.</li> <li>• During construction of spillway, the spoil piles should be properly shaped.</li> </ul>	<ul style="list-style-type: none"> <li>• The structural design will be undertaken in the state Designs organization with due consideration of codes and standard procedure.</li> <li>• Quarry location has been identified far away from the project site; whereas sand will be quarried from a distance place.</li> <li>• The spillway will be a concrete and masonry structure to be founded in solid rock having negligible erosion.</li> <li>• Apart from re-use of the excavated earth materials in the spillway bank, the rest will be used for construction of recreation areas.</li> </ul>
3.	<p>Landscape Consideration</p> <ul style="list-style-type: none"> <li>• Damages to the Vegetative cover due to construction should be minimum.</li> <li>• Burrow pits/ Borrow areas should be shaped and</li> </ul>	<ul style="list-style-type: none"> <li>• The existing access route will be renovated; with plantation on the road side.</li> <li>• Borrow pits shall be revegetated.</li> <li>• Quarries are located at faraway</li> </ul>

	revegetated. <ul style="list-style-type: none"><li>• Quarried operations should be minimum conforming to requirement.</li></ul>	places. Quarry operation by agencies shall be regulated as per guidelines.
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#### 7.10.4 Risks Assessment during Construction Period:

The construction of the spill way shall primarily comprise of the following activities:

- Leveling and excavation of the spillway area, which will involve use of earth moving equipment like dozers, scrappers, excavators, diggers etc.
- Construction of Spillway which will involve masonry and concrete work. For this purpose Heavy duty trucks shall be used for transport of building material like cement, sand, stone chips, rods etc. Cranes may be used for haulage of material.

Risks and Hazards involved during the construction process can be of significant magnitude if due care is not taken to be minimized through proper mitigation measures.

These are broadly discussed below in **Table No.C7-9**.

**Table No.C7-9: Potential Environmental Hazards and Mitigation Measures (During Construction Period)**

Sl. No	Activities	Impact	Hazard Potential	Remarks	Proposed Mitigation measures
1.	Excavation by Drilling and Blasting	Noise- Dust & Accident	Moderate Pollution	Occurs for temporary period	<ul style="list-style-type: none"> <li>Blasting operation as per prevailing explosive guidelines.</li> <li>Controlled blasting should be done to avoid fling objects</li> <li>Ensure effective warning system.</li> </ul>
2.	Disposal of solid wastes, construction debris	- Dust pollution - Land degradation	Moderate	For temporary period	<ul style="list-style-type: none"> <li>Carriage/ Transportation of mucks by covered transport vehicles.</li> <li>Sprinkling of water over the dumping yard and Haul roads.</li> </ul>
3.	Water Pockets in burrow pits	Water/Land pollution	Breeding of disease vectors	For a temporary period	<ul style="list-style-type: none"> <li>Small burrow pits to be avoided</li> <li>Bigger pits to be fairly levelled connected to drains and slopes turfed.</li> </ul>
4.	Migration of labour force	Occupational Health problem	Moderate	For a temporary period	<ul style="list-style-type: none"> <li>Labour camps will be properly maintained.</li> <li>Ensure health delivery to labourers free of cost.</li> </ul>
5.	Pollution of flow water source	Unsuitable for domestic use	Moderate	For Temporary period	<ul style="list-style-type: none"> <li>Dirking water will be supplied to workers at the construction site as well as in labour camps.</li> </ul>
6.	Other Manmade	Accident	Occasional	Rare occurrences	<ul style="list-style-type: none"> <li>Fire extinguishers will be kept ready for</li> </ul>

	disaster/Risks				<p>electric fires- Forest fires etc.</p> <ul style="list-style-type: none"> <li>• Safety measures for vehicular traffic.</li> </ul>
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#### 7.10.5 Anticipated Hazards and Mitigation Measures:

##### 1. Air Pollution:

- The earth moving machinery, cranes and transporting truck should conform to permissible BS standard i.e. BS III or BS IV so as to limit the emission level of pollutants like SO<sub>2</sub>, NO<sub>x</sub> etc.
- The idling running of construction equipments should be avoided to reduce green house gas emission.
- Regular maintenance of vehicles and construction equipment/machines should be done.
- To prevent dust pollution on roadways the material being transported in trucks need to be covered.
- The operators must be trained ones with valid license.

##### 2. Accidents during handling of Materials:

While handling materials mechanically suitable safety appliances should be used. Rigging and hauling jobs to be carried out by suitably trained and certified operators.

##### 3. Safe Operation and Safe Maintenance Procedures:

Safe operation procedures and safe maintenance procedures should be issued to operators, maintenance personnel and the contractual workers who are engaged in operation and maintenance/construction jobs. The documents should incorporate subjects like fire safety, housekeeping, safety in material handling, motor vehicle operational safety, safety in entering and working in a confined space, electrical safety, welding and cutting metals, ladder safety, road safety etc.

##### 4. Portable Electrical Appliances:

Electrical appliances like Hand lamps, electrical hand drills etc can cause electrocution. Such appliances must be thoroughly checked before being handled.

##### 5. Operation of Cranes:

Operation of cranes must be done by trained operators who must pass the specified test. The placement of crane vis-a-vis the boom length, load and placement distance must be supervised by qualified engineer for lifting of load. The cranes must be load tested and certified by competent person **authorized by Director of Factories and Boilers, Odisha.**

**7.10.6 Risks Assessment Process:**

The State Government Water Resource Department has process a Dam Break Analysis and Disaster Management Plan for operation.

**Anticipated hazards of Natural Calamities**

The project may be subjected to risks of extreme natural calamities like high cloud burst, Cyclones, Landslides and Earth quake etc. Mitigation measures against these extreme meteorological events are highlighted below.

**Table No.C7-10: Risks & Mitigation measure**

Sl. No.	Potential Indicators	Period of Occurrence	Likely Risk & Disasters	Mitigation Measures Proposed
1.	Strom Rainfall Cloud burst Historic Flood	Rare Occurrence	- Very high Floods - Submergence of area - Likely loss of property	<ul style="list-style-type: none"> <li>• Considered in the study of river hydrology</li> <li>• Structure is designed to pass 100 yrs Design Flood</li> <li>• Strengthen warning system to open gates prior to flood impinge</li> </ul>
2.	Cyclone	Periodic Occurrence	<ul style="list-style-type: none"> <li>• No risks to structures</li> <li>• Moderate risks for electric towers &amp; other installations</li> </ul>	<ul style="list-style-type: none"> <li>• No severe cyclone recorded in past decades.</li> <li>• Use stand by electricity supply (Generators)</li> <li>• Alternative arrangement for water supply to colony</li> </ul>
3.	Earth quake(Seismic Zone III)	Rare Occurrence	Moderate Risks to above ground structures	<ul style="list-style-type: none"> <li>• The structures will be designed with recommended seismic coefficient.</li> <li>• Check structures for any damage/ deformity in the post quake period.</li> </ul>
4.	Land Slides	Not noticed in the past	No risks	<ul style="list-style-type: none"> <li>• The area has been geologically mapped by G.S.I and found to exhibit stable rock.</li> </ul>

#### **7.10.7 Disaster due to Structural failure:**

- Disaster due to failure structures is a remote possibility as because the proposed, spillway structure will be constructed with concrete and masonry over competent rock foundation.
- However, risks due to operational failure of installations may not be ruled out altogether. It may appear if the gates do not operate smoothly either due to mechanical defects or due to human error.
- If such an event ever occurs, there may be flooding devastations to the downstream areas involving loss of property and concurrently some human lives.
- The Environment Ministry as well as the State Government has attached greater emphasis on Disaster Risk Reduction (DRR) planning and management interventions.

#### **7.10.8 Dam Break Analysis and Disaster Management Plan:**

The maximum hazard may manifest in the form of flood due to dam break. Hence there is need for dam break analysis. The dam break analysis has two objectives viz; (i) assessment of hazard potential of the dam break and ii) to provide an approach to Disaster Management Plan.

In order to assess the hazard potential of the dam, a Maximum Credible Failure (MCF) scenario is required to be visualized. The MCF scenario considered for the study is a 100-year flood coupled with a dam break, as suggested by CWC guidelines. The scenario should be given as an input to any dam break software, by which the flood/channel routing studies are carried out. The maximum water level that would be attained at various points on the downstream in case of dam break should be marked on a detailed contour plan of the downstream area to obtain the extent of inundation. The available contour map should have resolution lesser than increment in water levels due to dam break so that the inundation map could be prepared.

An assessment of the consequences of a dam failure on downstream areas is required and should include the following:

- An estimation of the magnitude of the dam break flood hydrographs resulting from hypothetical dam failure occurring with the reservoir at normal storage elevation and maximum storage elevation.
- A general description of the areas d/s that could be affected by flood water from a dam failure.
- Delineation of an inundation map delineating the maximum areal extent of flooding that could be produced by a dam failure. Inundation mapping should extend to a point d/s where the dam break flood would no longer pose a risk to life. This is often interpreted to be coincident with the point where inundation from the dam failure is within the 100 year floodplain for the affected watercourse.

The approach to Disaster Management Plan should delineate the needed organization for emergency response, outlines system of emergency preparedness consisting of emergency control centre, warning and communication systems and procedures of emergency preparedness.

In general, the DMP should describe procedures for responding to unusual or emergency situations and procedures for initiation of notification or warning of individuals who may be at risk in downstream areas. As a minimum, the EAP should include the following:

- Notification procedures (preferably in the form of a flow chart) and responsibilities for notifying d/s residents in the event of an impending dam failure
- A notification list that includes the names and telephone number of all affected d/s residents, dam owner and operator, local emergency official, and appropriate government agencies (including the dam safety office)
- Specific instructions for responsible parties to be followed at the dam site in response to emergencies such as floods, equipment failures, or other unusual events where the situation is evolving slow enough that immediate remedial action can be effective to prevent failure.
- Procedures to follow for emergency situations which probably would not lead to dam failure, but still could represent a hazard for downstream residents.

A general outline has been mentioned in the preceding paragraphs. Detailed disaster management plan need to be prepared by Dam Authorities in conjunction with State Government Officials for the main dam along with the additional spillway.

#### **7.10.9 Study of design earthquake parameter:**

The proposed spillway structure, a part of Hirakud dam is located in earthquake zone II as per seismic map of India.

The relevant seismic factors as prescribed by the National committee of seismic design have been considered by the Central Water Commission while preparing the design of the component structures. Accordingly the structural drawings have been finalized.