

DISASTER MANAGEMENT PLAN (DMP)

A comprehensive dam break analysis study has been undertaken by IIT Roorkee. This disaster management plan is generic in nature and addresses the different maximum credible accident scenarios that may occur in the area.

1.1 SCENARIO DEVELOPMENT

1.1.1 Heavy Rainfall/Storm in the Catchment

This can lead to two types of emergencies:

- Release of large flood volumes downstream through spillways.
- Slides in the reservoir rim

1.1.2 Earthquake

Following types of emergency situations can arise:

Damage to dam or spillway structures.

Slides in the reservoir rim.

Breaching of the dam due to earthquake leading to downstream flooding is not likely. The dam has been designed for the worst possible earthquake scenario in the region and is being constructed using most modern techniques.

1.1.3 Slowly Developing Situation:

Deficiencies in design/construction/maintenance can cause development of situation which are not emergent at the moment of occurrence and can be rectified, but if these attended to properly, these can develop into emergency situation. These deficiencies can manifest themselves through following situations giving sufficient notice for repairs and strengthening;

- Abnormal settlements, heaving, deflections, or lateral movement of concrete structures.
- Cracking or spalling of concrete and opening of contraction joints.
- Deterioration, erosion, or cavitation of concrete.
- Abnormal leaking through foundation or formed drains through concrete surfaces, construction joints, or contraction joints.
- Possible undermining of the downstream toe or other foundation damage.
- Unusual or inadequate operational behavior.

1.1.4 Civil Disturbance

This may result in willful tempering with equipment release of large volume of water by forcible opening spillway gates.

1.2 MANAGEMENT PLAN

1.2.1 For Events Due to Heavy Storm:

Possibility of this situation developing in the case Jamrani Dam is extremely rare because a very conservative estimate of design flood has been made and very flexible flood surplussing arrangements have been planned. Overtopping of the dam to extreme flood occurs only in the event of either when the design flood gates exceeded or when at the time of high floods, due to some defects, some gates of the spillways get struck up. Inflow design flood estimated for Jamrani Dam is 42,00 cumecs which is more than two times the maximum actual observed flood. Also Jamrani Dam has three spillways for lowering the reservoir level. The gates shall be electrically as well as manually operated. The question of jamming of all the gates simultaneously would not arise.

Jamrani Dam organization is maintaining a network of rain gauge, stations in the catchment area of Jamrani Dam. Besides the rain gauge stations, gauge discharge site has been established at Gola Barrage site. Stations are to be equipped with wireless sets so that any information can be transmitted to Control room at Damuadhunga Colony, Haldwani. Other than the monsoon period i.e. except from 15th June to 15th October, the daily rainfall data and the gauge discharge data will be transmitted to control room every fortnightly. During the rainy season till the reservoir level as below R.L. 750.0 the gauge data as well as rainfall data from rain gauge stations will be collected every four hours be transmitted to Control room only once in a day. When the dam reaches normal pool level at elevation 762 m. which would occur towards end of August of beginning of September, this information will be available to District Collectors of Nainital, Bareilly and Udham Singh Flood control Room, Irrigation Department Dehradun / Lucknow and Chief Engineer (North) Irrigation department Uttaranchal, Haldwani Central Flood Forecasting Unit Haldwani. The message would read as follows-“Full reservoir level reached at Jamrani Dam site. Hence forth addition inflows will be released through spillways”.

After the FRL is reached, the spillway Gate operating staff will work these shifts at dam site. The river stage at all gauge station will be recorded two hourly and its gauge data will be transmitted to control station every four hours. Similarly; if heavy rainfall occurs in any area of the catchment this would be immediately reported to the control room. Based on the above data, the spillway will be operated in accordance with instruction set out the reservoir operating policy whose copy would always be kept in the control room.

When there is only base flow in the reservoir or released from reservoir do not exceed 1200 cumecs, the information about flood being released from reservoir would be passed on to District Magistrate of Nainital, Bareilly and Udham Singh Nagar, flood control room Irrigation Deptt Dehradun / Lucknow and Chief Engineer (North) Irrigation Department Uttaranchal Haldwani, flood forecasting station central water commission, twice daily at 8.00 PM. When the spillway discharge exceeds 1200 cumecs and it is expected that inflow flood would further

increase, information about flood released may be given to above officials, every two hours. Flood forecast in terms of likely water levels downstream at various village and towns along the banks of the river during the course of the day may also be passed which shall be update with every release of information on the receipt of this information, it would be the duty of the District Administration to spread this information through use of loud speakers, radio and television and to arrange for necessary evacuation, if required. During the rainy season whenever heavy rain occurs in the reservoir area, the rim of the reservoir should be inspected for possible slide both during and after the rain. Special attention shall be given to those areas which have been identified as vulnerable from the experience of previous years. Any slide/imminent slide that is noted by the dam inspector would be brought to the notice of the Control Room indicating the location of the slide. The Engineer-in-charge of the dam will inspect the site and report on the likely volume of slide and whether any corrective actions are required. Based on this report suitable warning shall be issued

1.2.2 For Landslide

Land slides usually occur during rainy season either during heavy rainfall or immediately after it. Therefore, it is possible that reservoir is nearly full when a slide situation begins to develop. As

Soon a developing slide zone is noticed, it should be thoroughly examined to estimate the likely volume of the slide material and its nearness to dam. If the assessment indicates that sliding can lead to overtopping of the reservoir, a notice for alert situation should be given and the reservoir suitably lowered. It may be mentioned here that the situation of dam being overtopped due to rim slide is hypothetical in the case of Jamrani Dam. Jamrani Dam has a very large free board of 3.6 m. No slide can be big enough to fill up this empty volume.

1.2.3 For Earthquake

A short term micro earthquake recording has been conducted by the Department of Earthquake Engineering, University of Roorkee, Roorkee (U.P.) in the environs of Jamrani Dam site. The survey was primarily aimed at evaluating the seismic status of thrust (Main Boundary Fault MBF). This study also focused on the possibilities of Reservoir Induces Seismicity (RIS). For prognosticating the possibilities of Reservoir Induced Seismicity (RIS); the main conditions are (a) the availability or otherwise of the channels of seepage (b) existence of deeper tectonic conditions as stress build up in pre- existing fault planes and weak zones and (c) physical and textural properties of rocks (Huang Naian 1982). In addition, the rate of increase of water level in the reservoir and duration of high water level maintained also play an important role in the increase of RIS.

- In the context of Jamrani dam reservoir area; the sandstone inters bedded with claystone and siltstone of the lower Siwalik group occupies the large area; this sequence provides natural barrier against the seepage. Further the permeability of the material of the thrust plane near dam site was measured in one drill hole; indicate

values in the range of 7-10 Luegons; which is small to cause any appreciable seepage. Few more drill holes across the thrust plane would be drilled to take the average value of permeability along that plane.

- As the textural and physical properties of rocks are closely related to the occurrence of RIS, the plastic rocks under deformation may show settlement without producing vibration while on the other hand failure of brittle rocks produces vibrations.
- The reservoir environment such as one which is characterized by alteration of plastic claystone mudstone and sandstone as in as in Bhakra, Ramganga and Pong dams in India have not registered any RIS so far.
- The geological environment of the Jamrani reservoir area is practically of the similar type having similar sedimentary sequence of the Siwalik It may be anticipated therefore that there will be no significant change in the stress distribution in the creation of reservoir by constructing the Jamrani Dam.

Whenever an earthquake occurs which generates a peak ground acceleration of 0.1 g at dam a warning siren will switch on automatically. Immediately after the earthquake, quick inspection of site to find out whether any damage has taken place. If required, message will be sent immediately, by Control Room to District magistrate of National, Bareilly and Udham Singh nagar.

In case when no emergent situation arises at the dam site, after occurrence of the earthquake, message to this effect may be passed on to District Administration. However, the dam and other appurtenant works will be thoroughly inspected by senior Officer of department.

The officers shall thoroughly examine all the visible evidence as well as examine the readings of various instruments after earthquake to locate any internal or external damage to the dam. Remedial measures would be implemented as required.

1.2.4 Slowly Developing Situations

The responsibility for identifying and locating surface manifestations of deficiencies, which may gradually convert into serious emergencies, rests squarely with the Dam Maintenance Organization of Jamrani Dam. During the first filling of the reservoir after completion of construction very close watch shall be maintained during the gradual filling of the reservoir.

The dam shall be inspected regularly by dam authorities the condition of Dam. These inspections shall be scheduled during the period of low water to check the condition of structures normally submerged and during period of maximum water level to check structural behavior under full load or during maximum spillway discharges. A close watch for the health of the dam shall be kept during monsoon when the reservoir is approaching FRL.

Besides the Dam Maintenance Organization, a senior officer of the rank of Chief Engineer would inspect the project twice during the year, one before the onset of monsoon and the other after the monsoon. It will carry evaluation as per guidelines given in SEED manual

(Safety Evaluation of Existing Dam) of USBR. Beside the schedule set above, special inspections and emergency inspection shall be made when unusual potentially adverse condition develop at the dam site.

1.2.5 Civil Disturbance

In case of any Civil Disturbance, Officer-in-charge Control Room shall inform D.M., Nainital immediately requesting him to provide suitable force for protecting vulnerable points of the project.

1.2.6 Dam Break Scenario:

Dam break study has been analysed by U.P. Irrigation Research Institute using state of the art MIKE 11 software developed by Danish Hydrological Institute (DHI). Dam break analysis has been carried for 12 different combinations of breach width & time. Dam was assumed to fail considering a linear failure mode & rectangular breach up to the top half of the dam. The following observations have been made therein.

- The effect of change of breach width is more significant than to breach time. Both peak discharge & maximum water levels increase with increase in breach width and the peak of hydrograph is attained earlier.
- With the increase in breach time both peak discharge is delayed & maximum water level decreases but the effect is not so significant.
- The instantaneous failure of the dam is the worst failure case. The peak discharge from the dam is of order 43,237 cumec, when rectangular breach width is 60 m.

1.3 PREVENTIVE ACTIONS

In case of concrete dams, it is perhaps always possible to take suitable preventive actions to avoid catastrophic situation of breaching of dam provide a constant vigil is made through regular inspections and analysis of instrument data. A brief resume is provided here for the preventive actions to be taken for various developing situations.

In the sphere of preventive maintenance, it is necessary that all spillway gates and mechanical equipment for operating the gates be thoroughly inspected before the start of monsoon season every year.

An elaborate procedure for commission of storm and gauge data to Central Control Room has been discussed already and this should be strictly followed. If the information received through wireless message from various stations in the catchment indicates that the incoming flood is likely to exceed the inflow design flood and the reservoir is full, a notice for alert situation should be given and the reservoir appropriately lowered to receive the incoming flood.