

## **ALLAIN DUHANGAN HYDROELECTRIC PROJECT**

### **BARRAGE & DAM HEIGHT CLASSIFICATION AS PER ICOLD**

The water retaining and diversion structure of the Allain Duhangan Hydroelectric Project consist of the following components:

1. Allain barrage
2. Intermediate reservoir
3. Duhangan trench weir

In order to evaluate the safety of the reservoir and water diversion structures of the project, additional studies were carried out, as part of optimization studies. In this connection reference has been made to the provisions of International Committee on Large Dams (ICOLD) for defining the potential risk associated with the structures. The following ICOLD provisions have been considered to carryout the risk evaluation studies:

<b>Risk Factor</b>	<b>Extreme</b>	<b>High</b>	<b>Moderate</b>	<b>Low</b>
Storage Capacity (Mcum)	>120	1-120	0.1-1	<0.1
Height (metres)	>45	30-45	15-30	<15
Evacuation Requirement	>1000	100-1000	1-100	None
Damage Potential	High	Moderate	Low	None

As per the water retaining structure designs approved by the Central Water Commission, Government of India, the height of the diversion dam and desilting basin were within the moderate risk category (being 15 to 30 metre in height), but the forebay reservoir structure was found to be in high risk category (being more than 30 metre in height).

In view of the above conclusions, the location of the reservoir was changed and the height of the structure was simultaneously reduced. The revised cross-sections of the Allain barrage and the intermediate reservoir, based on the optimization studies, are enclosed as ***Annexure – I & Annexure – II*** respectively.

For measuring the height of the structures International norms have been followed, wherein, for design purposes, the height for the water retaining structure is considered from the base of the section to the full reservoir level. A copy of the American Society of

Civil Engineering Guide and Indian Standard, IS:6512 are enclosed as **Annexure – III & Annexure – IV** respectively. Both these figures clearly show that the total of the dam height 'H' is the vertical distance from the maximum reservoir level to the base of the section. This height 'H' is used in calculating the following:

1. Water pressure
2. Uplift force
3. Hydrodynamic pressure
4. Vertical base pressure
5. Safety against sliding
6. Safety against overturning

These factors are critical to the ultimate design of the dam structure. The depth of the cut offs including curtain grouting are not a part of the dam design, but emerge from the need to strengthen the foundation from seepage scouring and uplift force considerations.

The actual depth of the cut off is dependent on various other factors like foundation geology, soil characteristics and upstream pond level.

The cut offs or the grout curtains are provided below the base of the dam, to elongate the seepage path of the water and to increase the safety of dam against sliding. Hence, as far as the height of the dam is concerned, the depth of the cut offs or the grout curtains cannot be considered to be part of the dam structure.

As far as the actual structural height of the dam is concerned, it is greater than the dam height 'H' used for design purposes. This is due to the "free board" provided in the structure over the full reservoir level. Depending on design parameters, usually a free board of 0.5 to 2.0 metres is provided. Hence, the total concrete structure height in this case would be 'H+0.5 metre or H+ 2.0 metre, as the case may be.

In case of Allain Duhangan Project, the heights 'H' measured from the base of the section up to full reservoir level for the Allain barrage and intermediate reservoir is 12

metres and 14 metres respectively. With the free board provision, the heights are 14 metres and 14.5 metres respectively.

From the ICOLD table it may now be seen that the structures are in the low risk category. Accordingly, no evacuation requirement and damage potential is foreseen in the areas around the structures. However, in any case there is no existing habitation in the vicinity of these structures and sufficient arrangements are proposed for any eventuality.