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Indian Standard
CODE OF PRACTICE FOR DRAINAGE AND DEWATERING OF SURFACE/UNDERGROUND HYDROELECTRIC POWER STATION
( First Revision )

ICS 27.140

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BUREAU OF INDIAN STANDARDS
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NEW DELHI 110002

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FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Hydroelectric Power House Structures Sectional Committee had been approved by the Water Resources Division Council.

Drainage of hydroelectric power stations requires special considerations. General drainage provisions as stipulated in IS 1742: 1983 'Code of practice for building drainage (second revision)' and IS 1172: 1993 'Code of basic requirements for water supply, drainage and sanitation (fourth revision)' shall also apply for hydroelectric power stations. However, there are some features peculiar to hydroelectric power stations only, which are dealt with in this standard.

This standard was first published in 1968. In view of the experience gained during the course of its implementation the revision of this standard was undertaken. In this revision following modifications have been incorporated apart from updating provisions, in general:

a) Additional provisions relating to drainage and precautions for underground power station

b) Provision to meet emergency conditions for the drainage.

There is no ISO standard on the subject. This standard has been prepared based on indigenous manufacturers' data/practices prevalent in the field in India.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2: 1960 'Rules for rounding off numerical values (revised)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.
Indian Standard

CODE OF PRACTICE FOR DRAINAGE AND DEWATERING OF SURFACE/UNDERGROUND HYDROELECTRIC POWER STATION

(First Revision)

1 SCOPE

1.1 This standard stipulates requirements for drainage and dewatering arrangements for water discharges for surface/underground hydroelectric power stations.

1.1.1 The general drainage of the power house building shall, however, be done in accordance with IS 1742 and IS 1172 except that some special features peculiar to a power house building have been dealt in this standard.

2 REFERENCES

The following standards contain provision which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

<table>
<thead>
<tr>
<th>IS No.</th>
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<tbody>
<tr>
<td>554:1985</td>
<td>Dimensions for pipe threads where pressure tight joints are required on the threads (third revision)</td>
</tr>
<tr>
<td>778:1984</td>
<td>Specification for copper alloy gate, globe and check valves for water works purposes (fourth revision)</td>
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<tr>
<td>780:1984</td>
<td>Specification for sluice valves for water works purposes (50 to 300 mm size) (sixth revision)</td>
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<tr>
<td>2906:1984</td>
<td>Specification for sluice valves for water works purposes (350 to 1200 mm size) (third revision)</td>
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3 DRAINAGE AND DEWATERING SYSTEMS

The various systems suitable for power house building may be classified as:

a) gravity drainage system,

b) pressure drainage system, and

c) dewatering system.

4 GRAVITY DRAINAGE SYSTEM

4.1 General

This system includes floor drains leakage water from penstock coupling, generator coolers, scroll case liner, turbine cover, transformer coolers, drainage from formed drains at expansion/contraction joints, compressor cooling water, air conditioning cooling water, ventilation cooling water (for underground power house) hydrant fire fighting systems and for other discharges intermittent in character. The drained water is led into either of the following:

a) Tailrace or a drainage pipe laid outside the power house building as may be convenient. or

b) A sump within the power house building from which the water is pumped either to the tailrace or to a drainage pipe as given in (a) above.

4.1.1 It may, at times, be desirable to adopt both the alternatives given in 4.1 in any power house building to keep the amount of pumping from the sump, at minimum.

4.2 General Principles of Design

4.2.1 All walls in contact with water shall have drainage trenches along their interior faces with a suitable floor drain. These include outside walls with backfill against them and which are below annual high tailwater level.

In case of underground power station these also include seepage water from side rocks and roof.
4.2.1.1 Drains shall also be provided to take care of surface condensation, where likely, on pipe lines. Drainage trenches shall, preferably avoid crossing expansion joints, wherever it is unavoidable. Proper seals around the drainage trench shall be embedded to prevent entry of drainage water into the expansion joint.

4.2.2 Oil storage and purifier rooms shall have drains, with gravel pockets, of sufficient capacity to carry the flow from the sprinkler system.

4.2.3 Drains from the battery room floor and sink shall have a minimum slope 1 in 50, shall have no pockets or traps and shall discharge directly into the tailrace or the collection gallery (in case of underground power station). The battery room shall preferably be located above the highest water level of tailrace or collection gallery.

Suitable measures shall be taken to dilute the acid sufficiently in case it is discharged into drainage sump.

4.2.4 Drains from formed drains of expansion or contraction joints shall discharge into the gravity drainage system.

4.2.5 Drainage line to a main drainage header or sump shall be provided with suitable traps to prevent escape of odours. The discharge into the sumps shall be below the low water level to reduce noise. The vertical downspout in the sump shall have a 20 mm vent hole above maximum sump water level to prevent air lock. Vertical drains discharging into floor drains on lower floors need not be provided with traps.

4.2.6 All embedded pipes in the drainage system may be of mild steel or welded steel or any other suitable material. Horizontal lines shall have a slope 1 in 50 if practicable, with a minimum 1 in 100. No drain line shall be less than 100 mm in diameter except for short, sharply sloped runs with few bends from sinks or small pits and battery room, which may be 50 mm in diameter.

NOTE — Slopes mentioned in 4.2.6 do not apply to the main drainage header, if provided.

4.2.7 Whenever embedded pipes cross expansion or contraction joints, a socket/collar caulked with OAKUM, but not lead, shall be provided in the plane of the joint to permit minor movements without damage.

4.2.7.1 Pipes crossing construction joints between first and second stage concrete shall be long enough to prevent their choking during second stage concreting. Open end of pipes shall be closed with blank flange.

4.2.8 Floor drains projecting above the subfloor shall be installed when the floor finish is laid.

4.2.9 For surface and underground power stations, transformers shall have a suitable pit below it filled with gravel for the purpose of drainage of the hot, burning oil of the transformer to the oil sump. Suitable fire trap shall be provided to quench the fire of the burning oil (see Fig. 1 for typical diagram on fire trap).

4.3 Drainage Sumps and Pumps

4.3.1 Drainage sump shall have sufficient volume to permit a minimum 3 min running of the sump pump during each cycle of operation. Generally one litre per minute seepage may be assumed for every 6 m² of submerged wall. Minimum two deep well type sump pumps in working order are preferred, each having a capacity of at least 150 percent of the expected seepage discharge plus 100 percent of the continuous discharge from other sources. Float control or electrical pick up arrangement causes the respective pumps to operate as required with the second pump coming in operation when the first pump fails to handle the inflow. The remote control of the above device along with their signal indicators shall be provided either in the control room or on the turbine generator panel in the machine hall. An alarm indicator may also be provided to function when the maximum allowable high water level in the sump is reached.

4.3.2 To meet the emergency conditions, an emergency drainage pump of the same capacity as the other pumps may be provided. Separate discharge header for each pump shall be preferred instead of common header to facilitate the maintenance of valves.

5 PRESSURE DRAINAGE SYSTEM

5.1 The pressure drainage system is independent for each unit of the power house. It conducts cooling water from the bearings, generator, transformer and ventilation cooler of each unit to various outlets above maximum tailwater level. This system is subject to the losses in pipes and is designed to run full at all times.

In case of underground power houses, cooling water shall be discharged into draft tube directly.

NOTE — The detailed layout of the system is provided by the designer of the power station, in consultation/coordination with the supplier of the equipment.

5.2 The pipes for pressure drainage system may be mild steel or welded steel pipes. These, along with other fittings shall be capable of withstanding the expected pressure, including water hammer where applicable. The steel pipes and fittings shall conform to IS 554, IS 1239 (Part I). The welded steel pipe shall conform to IS 3589. The valves shall conform to IS 778, IS 780 or IS 2906.
FIG. 1 TYPICAL TRANSFORMER OIL DRAINAGE SYSTEM TO PREVENT FIRE AND BURNING OF OIL

5.2.1 At the time of installation of embedded pipes and fittings, it shall be ensured by testing or otherwise that the joints in the pipes and fittings are leak-proof against maximum expected pressure (1.5 times design pressure). Pipes of maximum length shall be used to minimize the number of joints.

6 DEWATERING SYSTEM

6.1 The general principles of design for dewatering the penstock, scroll case, draft tube and discharges into a tailrace or collection gallery through embedded pipes are given in 6.2 and 6.3.

6.2 Penstock and Scroll Case Drain Pipe

6.2.1 The penstock head gate shall be fully lowered and then the penstock and scroll case shall first be dewatered to tailwater elevation. This may be achieved in two ways:

a) by opening the turbine gate and allowing the water to flow into draft tube, or

b) by keeping the turbine gates closed. water may be allowed to flow into draft tube through a separate dewatering line.

NOTE — Where turbine inlet valve is provided and it is not considered necessary to dewater the penstock, the turbine inlet valve may be closed instead of lowering the penstock head gate.

6.2.2 The balance water in the penstock and scroll case is then drained below tailwater level and draft tubes emptied of water to its bottommost level. after ensuring that the draft tube gates are fully lowered and seals working, by any of the following methods:

a) By providing independent dewatering line into the dewatering sump for each individual unit or

b) By providing a common header carrying discharge from each unit to the dewatering sump, or

c) By closed circuit dewatering system having dry type dewatering sump (see Fig. 2 for typical diagram).

NOTE — System mentioned at (c) has the advantage over the (a) and (b) system that there is absolutely no possibility of flooding during dewatering.

6.2.2.1 The penstock or scroll case drain pipe shall be designed to dewater the scroll case and penstock into draft tube below tailwater level including head gate leakage, preferably in less than an hour. One tenth of one percent of the rated turbine discharge shall be allowed for head gates leakage.

A gate valve for drainage of penstock and scroll case shall be provided in a vertical line, if possible, and line from the case to the valve shall be as short and as direct as possible to prevent clogging by silt.
may also be desirable to provide connections for an air hose to be used to break up the silt, or to provide drain valves in the valve bonnet and at the bottom of the slot. Drains shall take off at the lowest point of the invert.

6.2.3 Spiral cases which are preceded by a penstock valve, such as butterfly valve, require an air and vacuum relief valve to permit dewatering and filling. This valve shall be of a size that will pass sufficient air to prevent pressure falling below one half of the atmospheric pressure inside the casing during dewatering and will open and release air when under maximum forebay pressure. Air relief vents shall take off at the top of the casing.

6.2.4 The dewatering take off from scroll case or penstocks shall have cast steel cut off valves placed as close as possible to the casing to provide a safe positive means of shutting off the water in case of emergency.

6.3 Draft Tube Drain Pipes
Each draft tube drain pipe under normal tailwater shall discharge not less than one half of one percent of the rated turbine discharge to aid in sealing the draft tube bulkhead gates. The pipe shall be capable of removing one tenth of one percent of the rated turbine discharge for leakage through the draft tube bulk head gates after sealing with the water level at the floor of the draft tube. Silting of the pipe from the draft tube to the valve shall be guarded against by providing compressed air connection. The discharge from the draft tube drain pipes is carried into the dewatering sump either through independent headers, or through a common header.

6.4 Dewatering Sump and Pumps
It is desirable to provide minimum of two dewatering pumps in working condition. The sump size and float control shall be designed for a minimum of 3 minutes running time per cycle. The inflow is determined by the size of the dewatering line from the draft tube. The dewatering header may be connected to the drainage sump through a gate valve to dewater excessive drainage (see Fig. 2).

6.5 Dewatering Pipes
6.5.1 The dewatering pipes, for the penstocks or scroll case as well as the draft tube and the header, for dewatering the sump are low pressure lines and may be of mild steel, welded steel or any other suitable material. Welded steel duly painted with antirust paints (inside and outside) shall be preferred.

6.5.1.1 Socket/collar similar to that mentioned in 4.2.7 shall be provided wherever the pipe crosses expansion or contraction joints.

6.5.2 The pipes and fittings from upstream and including the shut off valve shall be suitable for the maximum expected pressure including water hammer as in the case of pipes for the pressure system.
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Amendments Issued Since Publication

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