



**GOVERNMENT OF INDIA
CENTRAL WATER COMMISSION
DAM SAFETY ORGANISATION**

**Standardized Data Book Format,
Sample Checklist and Proforma for
Periodical Inspection of Dams**

**October 1988
New Delhi**

No. 3/19/NCDS/DS/11-15-64
Government of India
Dam Safety Organisation
Central Water Commission

428, Sewa Bhawan, R.K. Puram
New Delhi-110066.

Dated 7th October, 1988.

To

Sub:- Standardised Data Book Format, Sample Checklist
and Proforma for Periodical Inspection of Dams.

Sir,

As decided in the second meeting of the National Committee on Dam Safety held on 28.7.1988, the revised formats on the following items are enclosed herewith.

1. Data Book Format
2. Sample Checklist
3. Proforma for periodical inspection of dams.


In the revision of the above documents, comments received from the States have been incorporated.

Documentation of all the projects may be done in the Data Book Format. The Committee had desired that the proforma for periodical inspection of dams may be used in the initial stages, till the inspection teams are trained in dam safety inspection. The choice between the formats 2 and 3 for physical inspection of dams would be left to the States.

Copies for further circulation may kindly be made at your end.

Yours faithfully,

Encl:- as above.



(A.B. JOSHI)
Chief Engineer (DSO) and
Member-Secretary, National
Committee on Dam Safety.

Standardized Data Book Format, Sample Checklist and Proforma for Periodical Inspection of Dams.

INTRODUCTION

In order to evolve a uniform procedure for compilation of basic data on dams and for periodical inspection of dams, the following formats have been prepared:

1. Data Book format
2. Sample checklist
3. Proforma for periodical inspection of dams

Comments received from the States have been incorporated in the above documents.

Data Book format

Documentation of all projects may be done in the Data Book format which is the primary data base for the team evaluating the safety of a dam. This format is based on the 'Preliminary manual for safety evaluation of existing dams' published by the United States Bureau of Reclamation and suitably modified.

Sample checklist

The sample checklist prepared is based on the field examination checklist of the United States Department of Interior, Water and Power resources Service. This has been suitably modified to suit Indian conditions. The checklist is presented in a generalized form. Some items included under embankment dams, which are also applicable for concrete dams, have not been repeated. Detailed checklists have to be prepared for individual dams.

Proforma for periodical inspection of dams

This proforma is based on the proforma brought out by the Dam Safety Organization of Maharashtra State. Suitable modifications have been carried out and relevant information from similar proforma prepared by other States have also been incorporated.

Data Book Format

Proper assessment of dam safety involves a thorough review of design, construction and performance records prior to conducting a field examination. The Data Book is an unpublished document which is prepared before the initial safety inspection of each dam. This book is abbreviated, convenient source of information, summarizing all pertinent records and history related to the safety of a dam and is a reference for the evaluation team. This Data Book should answer most questions about the dam. A list of reference is included if additional information is needed. Continual updating of the Data Book will be required as future inspections are made, new problems arise, new investigations are undertaken and remedial treatments performed.

The format outlined in the Data Book should be followed as closely as possible. Adjustments to fit the conditions at a particular dam site may be needed. However, major changes in the outline may be avoided.

1. GENERAL

- 1.1 Scope of the project.
- 1.2 Description of dam & appurtenances.
- 1.3 Description of project and features related to safety of dam.
- 1.4 Photographs showing different phases of construction.
- 1.5 Salient features including Index Plan.
- 1.6 Key personnel
(include for each name, designation & address, office telephone & home telephone).
- 1.7 Access.
 - 1.7.1 Highways to dam.
 - 1.7.2 Closest town, railway station.
- 1.8 Emergency preparedness.
 - 1.8.1 Communications
 - 1.8.2 Downstream warning systems
 - 1.8.3 Auxiliary power
 - 1.8.4 Security of the site
- 1.9 Checklist for inspections.

2. GEOLOGY

- 2.1 General
- 2.2 Regional geology
 - 2.2.1 Geologic history
(include such items as rock types and tectonics).
- 2.3 Site geology
 - 2.3.1 Geomorphology
 - 2.3.2 Rock types
(include such items as lithology, petrography, mineralogy & engineering properties).
 - 2.3.3 Local structure
(include such items as description and significance)
 - 2.3.4 Special problems
(This should include appropriate subjects such as landslides, solution & subsidence).

- 2.3.5 Effect of geology on design.
- 2.3.6 Adequacy of investigations on state-of-the-art.
- 2.4 Seismicity
(Include design earthquake, current evaluation of maximum credible earthquake and status of any seismic evaluation or re-evaluation).
- 2.5 References
 - 2.5.1 Reports & data
 - 2.5.2 Drawings
 - 2.5.3 Memorandums

3. HYDROLOGY

- 3.1 Description of drainage basin.
- 3.2 Design floods
(include inflow design flood) – is it current?
- 3.3 Flood routing criteria
- 3.4 References and memorandums

4. RESERVOIRS

- 4.1 Description (include basin & reservoir)
- 4.2 Operation
- 4.3 Contour-capacity table
- 4.4 Evacuation capability
- 4.5 Reservoir geology
- 4.6 Landslides
 - 4.6.1 Summary
 - 4.6.2 Description
- 4.7 Restrictions
- 4.8 References
 - 4.8.1 Reports and data
 - 4.8.2 Drawings
 - 4.8.3 Memorandums

5. FOUNDATION

5.1 Description

- 5.1.1 General
- 5.1.2 Geology

5.2 Condition

- 5.2.1 General
- 5.2.2 Seepage
- 5.2.3 Deficiencies and problem areas

5.3 Design and analysis

5.3.1 Design

5.3.2 Description of treatment

- 5.3.2.1. Cutoff
- 5.3.2.2. Grouting
- 5.3.2.3. Drainage

5.3.3 Analysis

5.3.4 Special studies (effects of adjacent structure)

5.3.5 Adequacy of design

5.3.6 Remedial measures undertaken to remove the deficiencies, if any, and to overcome the problems encountered during construction.

5.3.7 Additional studies required.

5.4 Instrumentation

5.4.1 Structural

- 5.4.1.1 Description
- 5.4.1.2 Evaluation of Results

5.4.2 Seepage

- 5.4.2.1 Description
- 5.4.2.2 Evaluation of results

- 5.4.3 Frequency of readings
 - 5.4.3.1 Current provisions
 - 5.4.3.2 Adequacy
- 5.4.4 Comments of adequacy and justification for additional instrumentation.
- 5.5 Historical events relative to safety of dam
- 5.6 References
 - 5.6.1 Reports and data
 - 5.6.2 Drawings
 - 5.6.3 Memorandums

6. DAM

- 6.1 Description
(Type of dam, layout, galleries, general, etc.)
- 6.2 Condition of dam
 - 6.2.1 General
 - 6.2.2 Deficiencies and problems
- 6.3 Construction materials
 - 6.3.1 Description of materials
 - 6.3.2 Pre-construction testing
 - 6.3.3 Quality control during construction
 - 6.3.4 Post-construction testing
- 6.4 Design and analysis
 - 6.4.1 Leading criteria
 - 6.4.2 Analysis
 - 6.4.3 Special studies
 - 6.4.4 Adequacy of design
 - 6.4.5 Additional studies required

6.5 Instrumentation

6.5.1 Structural

6.5.1.1 Description of installation

6.5.1.2 Evaluation of results

6.5.2 Leakage and seepage

(include description of installation, evaluation of results and permeability tests carried out in the masonry / concrete, results & remedies.)

6.5.3 Reading frequency

6.5.3.1 Current provisions

6.5.3.2 Adequacy

6.5.4 Comments on adequacy and justification for additional instrumentation.

6.6 Historical events related to safety of dam.

6.7 References

6.7.1 Reports and data

6.7.2 Drawings

6.7.3 Memorandums

7. SPILLWAY

7.1 Description

[Intake structure, crest structure (gated, ungated, flash-boards, bridges), conveyance structure, stilling basin, exit channel, power sources, etc.]

7.2 Condition

7.2.1 General

7.2.2 Deficiencies and problems

7.2.3 Potential problems

7.3 Historical events

(Maximum releases to date, frequency of operations, damage reports, examinations, etc.)

- 7.4 Hydraulic design
 - 7.4.1 General
 - 7.4.2 Flood routing
(include use of outlet works and control of reservoir for floods.)
 - 7.4.3 Limitations
(effects of various gate malfunctions)
- 7.5 Structural design
(general, foundation, geology, drainage, anchorage)
- 7.6 Detailed drawings of gates, embedded parts & hoist equipments.
- 7.7 Instrumentation
[include settlement points (last reading, plotting and analysis) and other instrumentation]
- 7.8 Operation
 - 7.8.1 General
 - 7.8.2 Mechanical
 - 7.8.3 Maintenance schedules
- 7.9 References
 - 7.9.1 Reports and data
 - 7.9.2 Drawings
 - 7.9.3 Memorandums

8. RIVER OUTLET WORKS

- 8.1 Description
(Intake channel, intake structure, trash racks, closure method, upstream conveyance structure, gate chamber, downstream conveyance structure, control structure, stilling basin, exit channel, power sources, diversion during construction, bypass system).
- 8.2 Condition
 - 8.2.1 General
 - 8.2.2 Deficiencies and problems
 - 8.2.3 Potential problems

- 8.3 Historical events
(Maximum releases to date, modifications, damage reports, examinations, etc.)
- 8.4 Hydraulic designs
 - 8.4.1 General
 - 8.4.2 Discharge requirements
 - 8.4.3 Restrictions of operation
 - 8.4.4 Use with inflow design flood and flood routing
 - 8.4.5 Evacuation of reservoir (procedures)
- 8.5 Structural design
(General, foundation, geology, drainage, anchorage, etc.)
- 8.6 Instrumentation
[Include settlement points (last reading, plotting and analysis) and other instrumentation]
- 8.7 Operation
 - 8.7.1 General
 - 8.7.2 Restrictions
 - 8.7.3 Mechanical
 - 8.7.4 Flood and emergency conditions
- 8.8 References
 - 8.8.1 Reports and data
 - 8.8.2 Drawings
 - 8.8.3 Memorandums

9. POWER OUTLETS

- 9.1 Description
(Intake structure, trash racks, closure method, penstocks, turbines, tailrace, exist channel, etc.)
- 9.2 Condition
 - 9.2.1 General
 - 9.2.2 Deficiencies and problems
- 9.3 Historical events
(Damage reports, major malfunctions, examinations, etc.)

- 9.4 Hydraulic design
 - 9.4.1 Normal operation (discharge)
 - 9.4.2 Use with IDF flood routing
 - 9.4.3 Use with evacuation of reservoir
- 9.5 Structural design
(General, foundation, geology, drainage, anchorage, etc.)
- 9.6 Operation
 - 9.6.1 General
 - 9.6.2 Restrictions
 - 9.6.3 Mechanical
 - 9.6.4 Flood and emergency conditions
- 9.7 References
 - 9.7.1 Reports and data
 - 9.7.2 Drawings
 - 9.7.3 Memorandums

10. ACCESS ROADS

- 10.1 Description
(Type of road, length, bridges, maintaining agency, etc.)
- 10.2 Condition
 - 10.2.1 General
 - 10.2.2 Deficiencies and problems
- 10.3 References
 - 10.3.1 Reports and data
 - 10.3.2 Drawings
 - 10.3.3 Memorandums

11. MODEL STUDIES

12. OTHER FEATURES

(Any other features pertinent to the safety of the dam. Outline should be compatible with the outlines shown.)

13. REPORTS OF EXPERTS OR CONSULTATIVE COMMITTEES, IF ANY

14. SAFETY REVIEWS

Sample checklist for embankment and concrete dams

Date of inspection: _____

A. GENERAL

Sl.No.	Item	Remarks
(1)	(2)	(3)

1. Name of project
2. Purpose of project : Water supply / power / multipurpose / irrigation
3. Name of dam
4. Year of completion
5. First filling (years / levels)
6. Benefits accrued :
 - (a) Irrigation
 - (b) Water supply
 - (c) Power
 - (d) Other benefits

7. Important controlling levels (in metres)
 - (a) Top of dam
 - (b) Maximum water level
 - (c) Full reservoir level
 - (d) Sill level of irrigation sluices
 - (e) Sill level of scouring sluices
 - (f) Spillway crest level
 - (g) Minimum drawdown level
 - (h) Lowest river bed level
 - (i) Deepest foundation level

8. Important salient features
 - (a) Dead storage capacity
 - (b) Area of foreshore at FRL
 - (c) Design flood adopted (PMF / SPF / any other)
Give relevant magnitude
 - (d) Design spillway discharge capacity & type of spillway
 - (e) Type, number and size of spillway gates
 - (f) Location, sill level and capacity of low level outlets and scouring sluices.

- (g) Height of the dam in metres
 - (i) above deepest foundation
 - (ii) above lowest river bed
 - (h) Gross storage capacity in million cubic metres
 - (i) at FRL
 - (ii) at MWL
 - (i) Length of the dam (at crest) in metres.
9. Name and designation of the inspecting officer
 10. Date of inspection and the corresponding reservoir water level
 11. Maximum and minimum water levels reached during the last season with dates
 12. Maximum overflow during preceding monsoon with dates.
 13. History of past distress, if any, and brief details of remedial measures carried out.
 14. Does the officer-in-charge of the operation & maintenance of dam possess all the records as given in the Annexure I.
 15. When and by whom was the dam inspected immediately preceding this inspection?
 16. Are the items pointed out during the last inspection properly attended to? (if not, state deficiencies yet to be corrected)

Record required at site (referred in item 14 of General)

Records that may be required for proper inspection and maintenance shall be available at site. These shall be properly maintained and kept up-to-date by including latest information available. Data in respect of upstream gauging stations, flood warning system and communication channels, if installed, shall be properly maintained.

General

1. Final detailed project report and details of modifications done during construction and a set of final drawings (as executed).
2. Index Plan of the area in which the dam is located showing important towns, roads, rail routes and communication facilities.
3. Index Plan of downstream area showing natural flood zone, flood zones corresponding to spillway design flood and dam break flood and all important towns / villages and property lying in these flood zones.
4. Contour map of dam site extending upto 200 m or 10 times the dam height (whichever is less) on upstream and downstream, showing all features of the dam like toe lines, fills, drains, relief walls, access roads, etc.
5. Record drawings of longitudinal section of dam foundation or cut off trench showing details of foundation stratigraphy, stage-wise construction of COT filling and raising of dam section or embankment zoning details and foundation treatment.
6. Record drawings of cross-sections of dam showing details of foundation treatment, under seepage control, zoning, internal and external drainage, all protective arrangements and stage-wise construction
7. Contour Plan of dam site with foundation trench showing details of foundation treatment and foundation drainage.
8. Contour Plan of reservoir basin.
9. Contour capacity and area capacity curve.
10. Reservoir maps showing silted basin, if observed.

11. Plan of the catchment area showing rain gauge stations and capacities of upstream storages.
12. Material properties adopted for design.
13. Details of design criteria followed.
14. Design report on flood studies and spillway design flood.
15. Design reports of outlets, power outlets river sluices, intake, conduit, energy dissipation arrangements and details of gates of hoists.
16. Geological data on the foundations and abutments.
17. Copies of geological reports, details of special foundation and abutment treatment carried out.
18. Record of tail channel geology and tail channel erosion.
19. Instrumentation drawings with details.
20. Instrumentation data and behavioural record.
21. Details of communication system, telephones, wireless, etc., directory of important key officers, flood warning procedures.
22. Flood forecasting system.
23. Photographs showing various phases of construction, pre-construction, etc.

Earth – Rockfill dams

1. Stage-wise construction record of the dam showing volumes and heights achieved in each season and time rate of progress.
2. Record of special compaction done near concrete / masonry structures, abutment contacts and outlet locations, if available.
3. Summarized records of compaction, control sampling and complete laboratory and field test resulted on all record samples.
4. Foundation details and geology as observed.

5. Data of water intake tests.
6. Detailed drawings and record of relief well observations.
7. Design report for the earth dam, covering the under-seepage control, stability of embankment junctions with masonry dam, instruments installed, etc.
8. Drawings showing the typical cross sections, including zoning, drainage arrangements, detailed details of slope protections provided for, etc., as per actual construction.
9. Details and location of instruments embedded / installed in and around the structures.
10. Record of corrective measures, repairs and treatment that have been done subsequent to construction.
11. Details of design criteria followed.
12. Photographs showing all phases of construction.
13. Important inspection reports and reports of consultants.

Concrete / Masonry dams

1. Details of construction history, including stages of construction, particularly in low blocks where considerable time elapsed prior to resumption of work.
2. Summarized data on control tests, carried out during construction in respect of concrete, mortar and their constituent materials, if available.
3. Reports on hydraulic model studies.
4. Drawings showing the details of energy dissipation arrangements, including foundation levels of apron, training walls and end weir.
5. Details and location of instruments embedded / installed in and around the structure.
6. Summarized data of observations on embedded / installed instruments.

7. Detailed drawings of all service facilities like internal lighting, emergency lighting, drainage, etc.
8. Drawing showing the uplift measurements and pressure relief arrangements.
9. Summarized data of uplift pressures observed..
10. Summarized data of seepages, leaching observed in the drainage gallery and downstream face of the dam, their locations, etc.
11. Record of corrective measures, repair or treatment that have been done subsequent to completion.
12. Important inspection reports and reports of consultants.
13. Details of design criteria followed.
14. Photographs showing all phases of construction.

Operation and Maintenance

1. Gauge data of the river prior to the construction and after completion of work.
2. Detailed observations of flood discharges.
3. Detailed observations of hydraulic performance of energy dissipation basins.
4. Record of past performance stating briefly the defects developed and remedial measures carried out.
5. Drawings of outlets, maximum discharge capacity, maximum design operating head.
6. Standing orders regarding operation of the dam.
 - (a) Designers operating criteria.
 - (b) Standing operating procedures.
 - (c) Flood forecasting procedures.
 - (d) Gate operation procedures.
 - (e) Emergency Action Plan
7. Standard reference literature for operation and maintenance of reservoir, dam, ancillary work, gates, instrumentation, etc., including I.S. specifications, codes, manuals, manufacturers' literature, etc.

Checklist for
INSPECTION OF EMBANKMENT DAMS

DAM

Upstream face

- Slope protection _____
- Erosion _____
- Vegetative growth _____
- Settlement _____
- Debris _____
- Burrows or burrowing animals _____
- Unusual conditions _____

Downstream face

- Slope protection _____
- Signs of movement _____
- Seepage or wet areas _____
- Vegetative growth _____
- Drainage _____
- Unusual conditions _____

Abutments

- Seepage _____
- Cracks, joints & bedding planes _____
- Drainage _____
- Slides _____
- Vegetation _____
- Signs of movement _____

Crest

Surface cracking _____
Durability _____
Settlement _____
Lateral movement (alignment) _____
Camber _____
Drainage _____

Drainage

General _____
Longitudinal drains & dwarf bunds _____

Seepage and drainage

Locations (s) _____
Estimated flow (s) _____
Colour (staining) _____
Erosion of outfall _____
Toe drain and relief walls _____

Measurement

Method _____
Amount _____
Change in flow _____
Clearness of flow
 Colour _____
 Fines _____
Condition of measurement devices _____
Records _____

Special items

SPILLWAY

Approach channel

Vegetation (trees, etc.)	_____
Debris	_____
Slides above channel	_____
Channel slide slope stability	_____
Log boom	_____
Slope protection	_____

Control structure (observed operation)

Apron

Surface condition	_____
General condition of concrete	_____
Movement	_____
Settlement	_____
Joints	_____
Cracks	_____

Crest

Surface condition	_____
General condition of concrete	_____
Cracks or areas of distress	_____
Signs of movement	_____

Gates

Condition	_____
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Hoist equipment _____
Leakage _____
Lighting _____
Exercising frequency _____

Walls

Surface condition _____
General condition of concrete _____
Movement (offsets) _____
Cracks or areas of distress _____
Settlement _____
Joints _____
Drains _____
Backfill _____

Bridge

Condition of piers _____
Surface of roadway slab _____
Structural condition of slab & beams _____
Bridge bearings _____
Overall condition _____

CHUTE

Debris _____

Walls

Surface condition _____
General condition of concrete _____
Movement (offsets) _____
Cracks or areas of distress _____
Settlement _____

Joints _____
Condition of backfill _____

Floor

Surface condition _____
General condition of concrete _____
Baffle blocks / energy dissipators _____
Movement _____
Settlement _____
Joints _____
Drains _____
Cracks _____

Stilling basin (observed operation)

Debris in basin _____

Walls

Surface condition _____
General condition of concrete _____
Movement (offsets) _____
Cracks or areas of distress _____
Settlement _____
Joints _____
Condition of backfill _____

Floor (if visible)

Surface condition _____
Condition of concrete _____
Movement (offsets) _____
Cracks or areas of distress _____

Joints _____
Erosion _____

Outlet channel

Adequacy _____
Slope protection _____
Stability of side slopes _____
Flood bank and protective arrangement _____
Vegetation or other obstructions _____

Special items

Inlet works (if visible)

Trash racks _____
Trash rack concrete structure _____
Intake stop logs
 General condition _____
 Protective coating _____
 Seals _____
Inlet and upstream channel _____
Gate structure
 General condition _____
 Leakage _____
Metal work (air vent, gate stems, etc.)
 General condition _____
 Protective coating _____

Gate

General condition _____

Protective coating _____
Cavitation _____
Leakage (closed) _____
Exercising frequency _____
Operation at the time of examination _____

Gate hoist

General condition _____
Reservoir level gauge _____

Communications _____
Security _____
Alternate source of power _____
Flood forecasting system _____

RESERVOIR

Reservoir level gauge _____
Log boom _____
Landslides (individual designation
and Location for identification) _____

Special items

ACCESS ROAD

Condition _____

Ditches _____

Bridge

General condition _____

Vegetation at abutments & piers _____

Bridge supports _____

Foundations _____

Substructures – piers _____

Bridge bearings _____

Moving parts _____

Accumulation of birds' nests, etc. _____

Visual inspection of scour protection _____

Protective coatings _____

Main supporting members

Deteriorated and/or damaged members _____

Protective coatings _____

Bridge deck

General condition _____

Drainage _____

Expansion joints _____

Guard rails _____

Sign boards _____

Live load capacity _____

Special items

CHECKLIST FOR INSPECTION OF CONCRETE DAMS

DAM

Upstream face _____

Downstream face

 General condition _____

 Seepage on downstream face _____

 Measurement of seepage _____

Crest

 Offsets _____

 Roadway _____

 Walls _____

 Parapet wall _____

 Lighting, etc. _____

Galleries

 Concrete _____

 Metalwork _____

 Electrical _____

 Ventilation _____

 Seepage _____

Drainage gallery

 General condition _____

 Ventilation _____

 Cleanliness _____

 Lighting _____

 Movement (alignment) _____

 Cracks _____

 Drains & drainage
 (all drains should be open) _____

Location of seepages _____
Measurement of seepages _____
Amount of flow _____
Uplift pressures _____
Probing of foundation & formed drains _____
Chemical analysis of water _____
Amount of leaching _____
Drainage sump _____
Pumping arrangements _____
Alternative source of power _____

Special items

FOUNDATION AT DOWNSTREAM

Toe of dam

Leakage around dam _____
Location _____
Amount _____
Measurement methods _____

Instrumentation

Structural _____
Seepage _____
Reservoir level gauge _____
Operation during examination _____

Special items

SPILLWAY

Control structures

Crest _____

Sluices _____

Gates

Type of gate _____

General condition _____

Protective coatings _____

Leakage (closed) _____

Exercising frequency _____

Operation of gates at the time of examination _____

Controls for gates

Mechanical

Hoists _____

Wire ropes _____

Protective coatings _____

Electrical

Power supply _____

Standby power _____

Operation instructions _____

Stop logs

General condition _____

Protective coating _____

Seals _____

Stilling basin

Walls _____

Floor _____

Weir _____

River channel below basin

Riprap _____

Erosion _____

Vegetation _____

Special items

OUTLET WORKS

Intake

Trash rack _____

Concrete _____

Outlet conduit

Metal work _____

Cavitation _____

Control facilities

Gatehouse _____

Crane _____

Gate and controls

 General condition _____

 Protective coatings _____

 Cavitation _____

 Exercising frequency _____

 Operation at the time of examination _____

Control system

Electrical _____

Auxiliary power _____

Mechanical _____

Operating instructions _____

POWER FEATURES

(if related to safe operation or structural integrity of dam)

Intake structure _____

Trash rack

 General condition _____

 Cleaning arrangement _____

Intake gate(s) _____

Intake gate hoist _____

Gantry crane

 Mechanical _____

 Electrical _____

 Paint _____

 Operating instructions _____

 Operation during examination _____

 Storage area _____

Tail race

 Draft tube closure structure _____

 Draft tube gates _____

 Gantry crane (hoists) _____

Standby power unit

 Condition _____

 Exercising frequency _____

 Automatic features _____

 Operation during examination _____

Special items

PROFORMA FOR PERIODICAL INSPECTION OF LARGE DAMS

Date of inspection _____

B. GENERAL

Sl.No.	Item	Remarks
(1)	(2)	(3)

1. Name of project
2. Purpose of project : Water supply / power / multipurpose / irrigation
3. Name of dam
4. Year of completion
5. First filling (years / levels)
6. Benefits accrued :
 - (a) Irrigation
 - (b) Water supply
 - (c) Power
 - (d) Other benefits

7. Important controlling levels (in metres)
 - (a) Top of dam
 - (b) Maximum water level
 - (c) Full reservoir level
 - (d) Sill level of irrigation sluices
 - (e) Sill level of scouring sluices
 - (f) Spillway crest level
 - (g) Minimum drawdown level
 - (h) Lowest river bed level
 - (i) Deepest foundation level

8. Important salient features
 - (a) Dead storage capacity
 - (b) Area of foreshore at FRL
 - (c) Design flood adopted (PMF / SPF / any other)
Give relevant magnitude
 - (d) Design spillway discharge capacity & type of spillway
 - (e) Type, number and size of spillway gates
 - (f) Location, sill level and capacity of low level outlets and scouring sluices.

- (g) Height of the dam in metres
 - (i) above deepest foundation
 - (ii) above lowest river bed
 - (h) Gross storage capacity in million cubic metres
 - (i) at FRL
 - (ii) at MWL
 - (i) Length of the dam (at crest) in metres.
9. Name and designation of the inspecting officer
 10. Date of inspection and the corresponding reservoir water level
 11. Maximum and minimum water levels reached during the last season with dates
 12. Maximum overflow during preceding monsoon with dates.
 13. History of past distress, if any, and brief details of remedial measures carried out.
 14. Does the officer-in-charge of the operation & maintenance of dam possess all the records as given in the Annexure I.
 15. When and by whom was the dam inspected immediately preceding this inspection?
 16. Are the items pointed out during the last inspection properly attended to?

(if not, state deficiencies yet to be corrected)

Record required at site (referred in item 14 of General)

Records that may be required for proper inspection and maintenance shall be available at site. These shall be properly maintained and kept up-to-date by including latest information available. Data in respect of upstream gauging stations, flood warning system and communication channels, if installed, shall be properly maintained.

General

1. Final detailed project report and details of modifications done during construction and a set of final drawings (as executed).
2. Index Plan of the area in which the dam is located showing important towns, roads, rail routes and communication facilities.
3. Index Plan of downstream area showing natural flood zone, flood zones corresponding to spillway design flood and dam break flood and all important towns / villages and property lying in these flood zones.
4. Contour map of dam site extending upto 200 m or 10 times the dam height (whichever is less) on upstream and downstream, showing all features of the dam like toe lines, fills, drains, relief wells, access roads, etc.
5. Record drawings of longitudinal section of dam foundation or cut off trench showing details of foundation stratigraphy, stage-wise construction of COT filling and raising of dam section or embankment zoning details and foundation treatment.
6. Record drawings of cross-sections of dam showing details of foundation treatment, under seepage control, zoning, internal and external drainage, all protective arrangements and stage-wise construction
7. Contour Plan of dam site with foundation trench showing details of foundation treatment and foundation drainage.
8. Contour Plan of reservoir basin.
9. Contour capacity and area capacity curve.
10. Reservoir maps showing silted basin, if observed.

11. Plan of the catchment area showing rain gauge stations and capacities of upstream storages.
12. Material properties adopted for design.
13. Details of design criteria followed.
14. Design report on flood studies and spillway design flood.
15. Design reports of outlets, power outlets river sluices, intake, conduit, energy dissipation arrangements and details of gates of hoists.
16. Geological data on the foundations and abutments.
17. Copies of geological reports, details of special foundation and abutment treatment carried out.
18. Record of tail channel geology and tail channel erosion.
19. Instrumentation drawings with details.
20. Instrumentation data and behavioural record.
21. Details of communication system, telephones, wireless, etc., directory of important key officers, flood warning procedures.
22. Flood forecasting system.
23. Photographs showing various phases of construction, pre-construction, etc.

Earth – Rockfill dams

1. Stage-wise construction record of the dam showing volumes and heights achieved in each season and time rate of progress.
2. Record of special compaction done near concrete / masonry structures, abutment contacts and outlet locations, if available.
3. Summarized records of compaction, control sampling and complete laboratory and field test resulted on all record samples.
4. Foundation details and geology as observed.

5. Data of water intake tests.
6. Detailed drawings and record of relief well observations.
7. Design report for the earth dam, covering the under-seepage control, stability of embankments junctions with masonry dam, instruments installed, etc.
8. Drawings showing the typical cross sections, including zoning, drainage arrangements, detailed details of slope protections provided for, etc., as per actual construction.
9. Details and location of instruments embedded / installed in and around the structures.
10. Record of corrective measures, repairs and treatment that have been done subsequent to construction.
11. Details of design criteria followed.
12. Photographs showing all phases of construction.
13. Important inspection reports and reports of consultants.

Concrete / Masonry dams

1. Details of construction history, including stages of construction, particularly in low blocks where considerable time elapsed prior to resumption of work.
2. Summarized data on control tests, carried out during construction in respect of concrete, mortar and their constituent materials, if available.
3. Reports on hydraulic model studies.
4. Drawings showing the details of energy dissipation arrangements, including foundation levels of apron, training walls and end weir.
5. Details and location of instruments embedded / installed in and around the structure.
6. Summarized data of observations on embedded / installed instruments.

7. Detailed drawings of all service facilities like internal lighting, emergency lighting, drainage, etc.
8. Drawing showing the uplift measurements and pressure relief arrangements.
9. Summarized data of uplift pressures observed..
10. Summarized data of seepages, leaching observed in the drainage gallery and downstream face of the dam, their locations, etc.
11. Record of corrective measures, repair or treatment that have been done subsequent to completion.
12. Important inspection reports and reports of consultants.
13. Details of design criteria followed.
14. Photographs showing all phases of construction.

Operation and Maintenance

1. Gauge data of the river prior to the construction and after completion of work.
2. Detailed observations of flood discharges.
3. Detailed observations of hydraulic performance of energy dissipation basins.
4. Record of past performance stating briefly the defects developed and remedial measures carried out.
5. Drawings of outlets, maximum discharge capacity, maximum design operating head.
6. Standing orders regarding operation of the dam.
 - (a) Designers operating criteria.
 - (b) Standing operating procedures.
 - (c) Flood forecasting procedures.
 - (d) Gate operation procedures.
 - (e) Emergency Action Plan
7. Standard reference literature for operation and maintenance of reservoir, dam, ancillary work, gates, instrumentation, etc., including I.S. specifications, codes, manuals, manufacturers' literature, etc.

PROFORMA FOR PERIODICAL INSPECTION OF DAMS

Inspection of dams and ancillary works

B. EARTH DAM

Item No.	Item of inspection	Observation & recommendations, if any, of the inspecting officer	Remarks of reviewing officer
(1)	(2)	(3)	(4)

1. Downstream drainage

- (a) Are there any signs of water logging, slushy condition or growth of aquatic weeds on the downstream of the dam?
- (b) Are there any standing pools of water in the downstream area of the dam?
If so, give their locations and extent.
- (c) Are there any boils observed in the vicinity of the downstream toe of the dam?
- (d) Is the downstream area sufficiently clear and free draining?
- (e) What is the depth of ground water table on the downstream as evident from the existing walls in the vicinity of the dam?

Does the water table show any marked variation in accordance with the variations in reservoir water level?

- (f) Are all the exposed drains working satisfactorily?
- (g) Toe drains and cross drains
 - (i) Are the portions of longitudinal toe drain and exposed cross drains beyond the downstream toe of the

dam in regular section and freely draining?

- (ii) Is the patching to these drains intact?
- (iii) Is there any weeds growth in their drains?
- (iv) Indicate other defects noticed in these drains, if any.

(h) Outfall drain

- (i) Is the outfall drain in proper shape and grade and freely draining?
- (ii) Is the outfall drain properly cleaned and maintained?
- (iii) Does the outfall drain show any stagnant pools of water or weeds growth?

2. Surface drainage of downstream slope

- (a) Is the condition of the downstream slope drainage arrangements satisfactory?
- (b) Is the paving to these drains intact?
- (c) Are all the drains properly maintained and free of vegetation growth and debris?
- (d) Does the slope have a tendency to develop severe rain cuts at any location?
- (e) Enumerate any other defects noticed in the surface drainage of downstream slope.

3. Seepage measurements

- (a) Is the quantity of seepage being daily or periodically measured with respect to water level in reservoir and recorded? Please

check the registers and record observations.

- (b) Does it show any abnormal rise or fall? If so, does it have any relation to a certain reservoir level elevation?
- (c) Does the seepage flow show a turbid colour at any stage? Was such a phenomenon observed at any stage at any location in the past?
- (d) What is the measured rate of seepage flow with date and reservoir level?
 - (i) On the day of present inspection
 - (ii) Maximum since last June
 - (iii) Minimum since last June.
- (e) Is the portion upstream and downstream of measuring points of seepage easily accessible with proper steps and path and free vegetation growth?
- (f) Are the measuring points properly located, constructed and maintained so as to give accurate and reliable measurements of seepage?
- (g) Is the method of taking seepage measurements satisfactory?
- (h) What is the design seepage discharge? State your observation on comparison.

4. Earth dam section crest

- (a) Is the crest profile at proper elevation?

Does it show any signs of excessive and / or uneven settlement? If so, indicate such locations and extent of settlement (surface settlement points must be

installed for observing this aspect).

- (b) Is the surface of the crest free from undulations and local depressions or heaving?

Does it provide an all-weather road surface?

- (c) Does it develop any visible cracks in transverse or longitudinal directions? If so, attach a map showing their locations and extent. Depth and width of cracks must be ascertained by taking open trenches extending below the bottom of cracks.
- (d) What is the condition of the edges of crest? Is ramp provided? Any road crossing provided? Have they got eroded and cut up resulting in reduced effective width?
- (e) Is the crest free from local slips throughout its length on either sides?
- (f) Do the headers, guard stones and parapet wall provided at the edges of the crest appear in proper profile and plumb?

5. Earth dam section – upstream and downstream slopes

Indicate the general conditions of upstream pitching, downstream pitching / turving and rock toe.

- a) Do the upstream and downstream slopes show any sign of bulging or concavity? If so, indicate their locations and extent.
- b) Does the section of the dam and both the slopes appear structurally sound and stable?

- c) Are any longitudinal or transverse cracks noticed in any part of the slopes?
- d) Were any signs of distress to stability of slopes noticed at any time in any part of the dam? If so, give brief details of the incidents and location, the method of treatment adopted and its effectiveness.

Indicate the general conditions of upstream pitching, downstream pitching / turfing and the rock toe.

- e) Is there any profuse growth of bushes or weeds over any portion of the dam? If so, indicate the locations.
- f) Do the upstream or downstream slopes show existence of crab holes or holes made by rodents or burrowing animals or anthills? If so, indicate the locations.
- g) Are there any wet or slushy patches and concentrated leaks, springs or trickles observed on the downstream slopes or the toe? If so, indicate their locations and extent. Please look out for patches of extensive vegetation growth and examine them carefully and record your findings.
- h) Are all the rain cuts and erosion channels properly treated and made good?

Please indicate location of recurring damages, if any.

6. Junction earth work with masonry / concrete dam sections and outlets.

- (a) Is there any existence of leaks, springs or wet spots in the earth work in the vicinity of the junctions

between earth work and masonry works? If so, what is the approximate rate and colour of the leakage? Does it turn turbid at any time? Please ascertain from enquiries and record the findings.

- (b) Is there any tendency for separations cracking, settlement or upheaval of the earth work in the vicinity of masonry or concrete? If so, indicate the locations and the exact nature of deficiency.
- (c) Is there any tendency for surface erosion at the junctions?
- (d) If the outlet conduit is located in the earth dam section, is the entire length of the conduit in perfect order & profile and free from off sets, open joints, cracks and leakage?

Examine the conduit carefully from the downstream or from inside, if possible, and indicate the deficiencies observed, if any.

- (e) Check the conditions of the crest and slopes, especially in the zones adjacent concrete structures. Detect the deformations, settlements, cracks or other distress conditions caused by external erosion due to wind, rain, etc. Set up permanent observation system for the same at the places of occurrence. Seepage at junctions between earth dam and masonry concrete retaining wall or corch type junctions with concrete dams is a possible source of trouble and should be carefully watched.

7. Relief wells

- (a) Are the relief wells in good working conditions and functioning well?

- (b) Are the relief wells properly cleaned periodically?
- (c) Please indicate the dates of last cleaning and the next cleaning due.
- (d) Are the necessary plant & equipment for cleaning the relief walls available with the office.

8. Breaching section (if provided)

- (a) Is the breaching section easily accessible?
- (b) Is the condition of the breaching section satisfactory?
- (c) Is the note of instructions as to when and how to operate the breaching section available on record?
- (d) For reconstruction after the breach, are the following items decided in advance?
 - (i) Quarry for embankment material.
 - (ii) Suitable routes of access.
 - (iii) Agency, plant & machinery for its reconstruction.
- (e) Is the maintenance staff fully aware of the instructions at (c) and (d) above?
- (f) Ascertain and indicate the latest event of operation of breaching section and its performance.
- (g) Is the surplus course from the breaching section acquired upto natural valley?
- (h) Is the course formed?

- (i) Is the surplus course assigned later as agriculture land or house site?
- (j) If so, what steps are taken?

Note: For items pertaining to spillway, gates, sluices and outlets, etc., please refer points 4,5,6,7,8,9,11,12,13,14 under Masonry / Concrete dams.

PROFORMA FOR PERIODICAL INSPECTION OF DAMS

Inspection of dams and ancillary works

C. MASONRY / CONCRETE DAM

Item No.	Item of inspection	Observation & recommendations, if any, of the inspecting officer	Remarks of reviewing officer
(1)	(2)	(3)	(4)

1. Upstream and downstream faces

- (a) Examine the monolith and construction joints for such defects as cracks, open joints, spalling, seepage, leaching, etc., and indicate the findings.
- (b) Is the upstream face of the dam in good condition? If not, indicate the nature and extent of deficiency.
- (c) Is any spalling or cracking observed on the downstream face, especially near the zone of concentration of stresses or location of abrupt change in geometry, or at the openings? If so, indicate the details of observations.
- (d)
 - (i) Is there excessive seepage / sweating at any location on the downstream face of the dam?
 - (ii) Whether the observations are analyzed and compared with the theoretical assumptions made in the design?
 - (iii) Remedial measures in case of large variations.

- (e) Examine the roadway / top of the dam for offsets, opening of construction joints, condition of parapet wall, drainage, lighting, etc.

2. Drainage gallery

(a) General

- (i) Is the drainage gallery easily accessible and does it have adequate lighting facilities with sufficient stand by units of lighting? If not, indicate the deficiencies.
- (ii) Are proper arrangements made for the measurement of seepage into the gallery?

Is the seepage from

- Porous pipes
- Foundation drains
- Monolith joints
- Other seepage locations
- measured separately

- (iii) Are the above arrangements satisfactory?

(b) Seepages from foundation

- (i) If there has been a substantial reduction in the seepage through the foundations, is it due to chocking of the drain holes?
- (ii) Are all the foundation holes periodically cleaned?

Indicate the last date of such cleaning and extent of variation

observed in the seepage discharge before and after the cleaning.

- (iii) Are measurements of uplift pressures taken regularly? What was the uplift like at highest reservoir level during last season? Is observed uplift within design limits?
- (iv) Are the seepage water and the deposit, if any, from the seepage being regularly examined for chemical composition?

If so, indicate the results and the probable source of dissolved salts, if any.

- (v) Are any seepage water springs observed in the downstream area anywhere?

If so, indicate the locations and state the physical nature of this seepage. Look out for such seepage spots, particularly near the dykes fault zone, etc. Ascertain if chemical tests are made of water samples from such springs for dissolved salts.

(c) Seepage from body wall (dam and spillway)

- (i) What is the total seepage into gallery from the porous pipes in the dam at lake full condition? How does it compare with the seepage (for the corresponding water level) when the reservoir was first filled?
- (ii) If there has been a substantial reduction in this seepage, ascertain and indicate the probable reasons therefor.

- (iii) Is a statement showing the surface area of the dam (water side) calculated block-wise for each metre of rise of water level available?
- (iv) What was the total seepage per square metre of upstream face submerged during inspection?
- (v) Is there any excessive seepage from any body drain or any other locations in the gallery?
- (vi) What steps are being taken for regular periodical cleaning of the porous pipes?
- (vii) Has there been a tendency for gradual reduction of drainage through pipes and progressive appearance of sweating on the downstream face of the dam?
- (viii) Has there been considerable leaching from the seepage water and deposition of lime near the seepage exist spots?
- (ix) Are the samples of the seepage water and the reservoir water being regularly tested for reactive and corrosive properties?
- (x) Has the total leaching been estimated?
- (xi) Is the seepage on the downstream face of the dam measured?

What was the seepage on the date of inspection? What was the maximum seepage during the past one year?

3. Structural performance

- (a) Are there any signs of structural distress noticed in the dam, spillway and foundations in the form of:
- (i) Excessive deflection
 - (ii) Tendency of gradual sliding.
 - (iii) Cracking and upheaval of settlement in any part of the body wall or foundations.
 - (iv) Excessive uplift.
 - (v) Excessive seepage and leaching through the body of the dam and the foundation.
 - (vi) Conspicuous weathering of materials or components in any portion of the body wall or the foundations.

4. Spillway gates

Spillway gates and other gates wherever applicable.

- (a) Are the following documents available at site?
- (i) A complete set of detailed design calculations together with the drawings of gates, gate grooves embedded parts, hoisting mechanism and controls, etc.
 - (ii) Designers operating criteria and / or detailed operating instructions for the various types of gates installed in the dam.
 - (iii) Maintenance schedules specifying each operation its frequency, and for due and done dates.
 - (iv) Operating instrumentation with "Dos and don'ts" for all operational units.

- (b) Is the condition of the steel surfaces and the surface paint deteriorated?
- (c) Are any connecting bolts of rubber seals loosened or damaged? If so, indicate the details of defects.
- (d) What is the general condition of rubber seals? Do any of the rubber seals show signs of weathering, hardening, cracking or tearing and damage?
- (e) Are the rubber seals of side and bottom touching uniformly all along the sealing surface?
- (f) Do the rollers (wherever applicable) touch the track plates uniformly? Are the rollers well lubricated?
- (g) Are the electrical meters, gear systems, limit switches, brakes, bush bearing, etc., of hoist mechanism well lubricated?
- (h) Is the operation of the above, smooth and satisfactory? If not, list out individual results and observations.
- (i) Are the embedded parts of spillway gates, emergency gates and stop logs in sound condition and free from corrosion, uneven wear, cracking chipping and dents?

If not, state the nature of defects or deficiencies and observations, if any, regarding such defects.

- (j) Check the following for structural soundness of all members and welded bolts and riveted connections, uneven wear, uneven bearing, cracking, chipping and dents and indicate the findings.
 - (i) Gate leaf and stiffeners
 - (ii) End arms
 - (iii) Trunnion girders
 - (iv) Stop logs
 - (v) Lifting beams
 - (vi) Gantry cranes
 - (vii) Tracks
 - (viii) Bridge structures
- (k) Are the trunnion bearings of radial gates properly lubricated?
- (l) Is there any damage or weathering caused to the seal plates? If so, indicate the nature of damage noticed.
- (m) Is the full length of wire rope of the hoist in sound condition and free from broken strands?
- (n) Is the electrical wiring in sound condition?
- (o) Is the alternative power system for gate operation working properly?

Give details of generating sets and standby units and the time required to operate all gates on the alternative power system, on the basis of actual trial operation. Check for diesel stock for operation of generator, battery charger available. Battery in spare.

- (p) Is the operation, which is a standby in case of electrical hoists, tried and found satisfactory? Please take test trial and ascertain.
- (q) Are all the nuts of connecting bolts and anchorages properly tightened?

In case of trunnion girder anchorages tightening torque which is generally specified should be adhered to.

(Note: After inspection of the various items, it is necessary to draw up a list of actions needed to be taken and pursue matters with the concerned agency.)

- (r) Are the hydraulic hoists working satisfactorily?
- (s) Are the trunnion hub and the brackets well maintained?
- (t) Are the trunnions likely to get submerged during actual working of the spillway?

If so, ascertain the causes for the same and specify. Please enquire for occurrence of such events, if any.

- (u) Are any of the mechanical or structural components and fastening or seals subjected to excessive wear? If so, please give details. Is there any tendency for recurring damage to any particular components? If so, please give details.

- (v) Is sufficient stock of spare which need frequent replacement maintained at the site?
 - (w) Is the staff posted at the site, maintenance and operation of gates, hoists, equipments and electrical installation well experienced, fully trained and conversant with the job requirements and responsibilities?
 - (x) What is the exercising frequency? When were the gates last exercised?
 - (y) Performance during inspection.
 - (z) Change over switches for main power supply to generator supply are provided.
5. Spillway bridge, hoist bridge catwalks, and other bridges where applicable.
- (a) Are the decking, girders and structural supports of spillway bridge, hoist bridge and catwalks structurally sound?
 - (b) Is the floor of the bridge structurally sound and safe?
 - (c) Is there satisfactory arrangements to prevent unauthorized entry into the control structures and bridges?
 - (d) Are the structural members and joints sound and free from corrosion?
 - (e) When were the steel components painted last?
 - (f) Is the surface of steel work and paint satisfactory?

- (g) Is the parapet or railing over the bridges sound and safe?
- (h) Are all the bearings, bearing pads and pier caps structurally sound?
- (i) Are all the track plates for gantry cranes laid over such bridges structurally sound and intact?

6. Energy dissipation arrangements

- (a) Can the tail pond be drained easily for inspection of the stilling basin? If not, what are the short comings?

Please ascertain and indicate the last event of inspection of stilling basin.

- (b) From the examination of the levels and contour plans and reference marks in tail channel, ascertain if there is progressive erosion and retrogression in the tail channel.

Indicate the extent and location of such erosion with reference to the various components of dam's spillway outlet, powerhouse, etc.

- (c) Is the concrete surface of the stilling basin and apron in good condition?

Are there any indications of pitting cracking, spalling or wearing of the surface of bedding concrete? If so, please give details of the nature and extent of the damage.

- (d) Is there any indication of abrasion and cavitation damage (pitting of concrete), especially at friction block, chute blocks the surface near the lower tangent point and the end sill?

If so, please give the details of nature and extent of the damage.

- (e) Is the under-drainages of the stilling basin satisfactory?

Are all the open drain holes clear and functioning well?

7. Walls

Guide walls / divide walls, junction walls / return walls / spray walls, etc. (strike out whichever is not applicable)

- (a) Are all the locations of such wall accessible for inspection, maintenance and repairs?
- (b) Is the drainage of back sides of the walls (wherever applicable) from the weep holes satisfactory?

If not, indicate the nature of deficiencies.

- (c) Is there any tendency for the water to undercut the ends of the walls?

If so, please give details of nature and extent of damage.

- (d) Is there any foundation erosion or scour noticed in the vicinity of such walls?

If so, give the details of nature and extent of such damage.

- (e) Is there any surface erosion / damage caused to face or body of such walls?
- (f) Do any of the walls show symptoms of unequal settlement development of cracks and tilting?

If so, give details of the defects noticed.

- (g) Is there any damage to guide bunds?
If so, give details of the damage.

8. End Weir

- (i) Is it accessible?
- (ii) Is there any erosion pitting or spalling of the concrete or masonry surface? If so, give details.
- (iii) Is there any scour noticed on the immediate downstream of such weir?

If so, give details of location and extent of such damage.

9. Hydraulic performance of energy dissipation arrangements.

- (a) Do the flow conditions in the stilling basin have a tendency to draw rocky material into the bucket and cause its churning and abrasion damage to the surface of buckets, baffle blocks, apron and end sill?
- (b) Is the hydraulic performance in proper agreement with the results of model studies?

Ascertain the performance from observed tail water rating curves and deficient observation, if any, such as weep outs and excessive erosion under plunge pools and location of secondary rollers and retrogression.

10. Instruments installed and observations

- (a) Are all the instruments installed properly accessible?

Are all the locations properly lighted, ventilated and adequately protected from possibilities of damage?

- (b) Are all the instruments in proper working order?

Ascertain the cases of instruments going out of order and indicate.

- (c) Are all the registers of observations posted upto date? Please take test observations and initial the registers.
- (d) Are all the plottings of the instruments data completed upto date?
- (e) Are sufficient stocks of spares, gauges, master gauges, stationery items, etc., maintained at the site for uninterrupted data collection?

11. Outlet

- (a) Is the air vent periodically cleaned?
- (b) Are there any structural damage to the intake walls such as leakage noticed through walls?
- (c) Is there any leakage observed through the conduit, concrete or masonry?

If so, give details of its location and extent.

- (d) Is there any damage noticed to the conduit concrete, breast wall and gate slots?
- (e) Is the by pass valve (wherever provided) operating satisfactorily?
- (f) Take operating trials of the following as provided and record the observations and defects noticed, if any.

- (i) Service - gate
- (ii) Emergency - gate/s
- (iii) Stop-log - gate/s
- (iv) Sluice - valves

- (g) Are the trash racks (wherever provided cleaned before monsoon?
- (h) Are there vibration and noise noticed in operation of outlet gates at any time?

If so, are any periodical observations taken to ascertain their severity?

- (i) Is the energy dissipation arrangement working satisfactorily for all discharges?
- (j) Is there any structural damage to the energy dissipation structures? If so, give the details of nature and extent of the damage.
- (k) Is the conduit structurally sound and reasonably leak proof?

If not, give details of nature and extent of the effects.

Is it possible to examine the conduit from inside?

- (l) Is there any seepage noticed around the conduit as ascertained from the observations of the downstream conditions? If so, is it likely to cause (in case of earth dams) erosion and piping?

12. Outlet gates

- a) Is the surface of gates and the paint deteriorated?
- b) Are the connecting bolts of rubber seals loosened or damaged?

- c) Do the rubber seals show signs of weathering & damage and need replacement?
- d) Are the rubber seals of sides and bottom touching the bearing surface uniformly?
- e) Do all the rollers touch the track plates?
- f) Are the rollers well lubricated?
- g) Is the operation of outlet gates smooth?
- h) Are the stem rods for lifting the gates straight?
- i) Are the actual operation of lifting and lowering of the gates and hoist mechanisms smooth and satisfactory?
- j) Are all the gears and hoist mechanisms well lubricated?
- k) Is the storing arrangement for emergency gate leaves and the stop logs in satisfactory condition?
- l) Are the seal plates in sound condition?

If not, ascertain the type of damage and indicate.
- m) Is the full length of wire rope (wherever applicable) of the hoist in serviceable condition and free from any broken strands?
- n) Are all the nuts of connecting bolts and anchorage properly tightened?
- o) Are all the lifting beams in proper order and sound condition?

If not, ascertain the nature and extent of damage and indicate.

- p) Do any of the mechanical or structural parts of the gates, fasteners or hoists show signs of excessive wear? If so, please give details.
- q) Is there any tendency for recurring damage to any particular component of components? If so, give details.
- r) Is sufficient stock of spare which needs frequent replacement maintained at the site?
- s) Whether hand cracks are kept under lock and key and not attached on hoist mechanism when operated by electrical energy?
- t) Whether warning sign indicating "Danger, Do not switch on" is hung during maintenance?
- u) Whether the operating crane is in "A" condition and the operators are instructed to lift the emergency gates / stop logs in a vertical direction so that allowable carrying capacity is not exceeded?
- v) Whether there is a "standby" power supply?
- w) The alternative sources of power
 1. Is the generator in the working condition
 2. Frequency of exercise
 3. Is it developing full voltage.
 4. Is the wiring intact and is the changeover switch in working condition?
 5. Are the spares available at site?

13. River outlet / river sluice & gates

- (a) Is the overall condition of river outlet works / river sluices satisfactory?
- (b) Is the operation of the gate satisfactory as ascertained by taking an operating trial? If not, indicate the defects noticed.
- (c) Are the trash rack (wherever provided) cleaned before monsoon?
- (d) Is there excessive silting on the upstream of the sluice?
- (e) When were the gates last opened for desilting, etc.?
- (f) Please indicate the approximate quantity of the leakage through the gates, if any?
- (g) Is there any seepage or leakage through the conduit surface?
- (h) Is there any damage to the upstream and downstream conveyance structures of the conduit?
- (i) Is the condition of energy dissipation arrangement satisfactory?

If not, indicate nature and extent of damage.

- (j) Is there any retrogression noticed in the downstream channel?

If so, give details of nature and extent of damage.

14. Power outlet

- (a) Is the overall condition of power outlet satisfactory?

- (b) Is the operation of gates smooth and satisfactory as ascertained by taking operating trials?

If not, indicate the nature of the defects noticed.

- (c) Are the trash racks cleaned before monsoon?
- (d) Is there excessive silting in the approach channel on the upstream of power outlet?
- (e) Is there any seepage through the conduit surfaces?
- (f) Is there any cavitation damage to the inside of the conduit and penstock of the HRT and pressure shafts?
- (g) Are all the valves functioning properly?
- (h) Are there any vibrations induced into the dam and appurtenant works while the outlet is opened or the machines are running?

15. Emergency preparedness

- (a) Are the project officers well conversant with the Emergency Action Plan, reporting procedures, warning procedures?
- (b) When was the Emergency Action Plan last reviewed?
- (c) Are the communication directories updated?
- (d) Are the concerned authorities informed about the system of emergency reporting procedures and warning?
- (e) Are the inundation maps updated?

- (f) Are available safety spots on the downstream of the dam identified and made known to the concerned authorities?
- (g) Is the communication system working satisfactorily?
- (h) Are adequate warning devices and facilities provided at the dam?
- (i) Is the downstream warning system operational?
- (j) Are proper arrangements made for security of the dam and preventing cases of unauthorized trespass, vandalism and sabotage to the dam works?
- (k) Is downstream warning system operatable on alternative power supply?

16. Access roads

- (a) Is there a properly constructed and well maintained all-weather access road to the dam site?
- (b) What is the type of pavement of the access road and its condition?
- (c) Are there properly constructed and well maintained access roads arrangements to the following components for inspection, maintenance and repairs?
 - (i) Top of dam
 - (ii) Spillway
 - (ix) Gates and hoisting arrangement
 - (x) Drainage gallery
 - (xi) Bridge structure

- (xii) Downstream stilling basin
 - (xiii) Junction and abutments
 - (xiv) Outlet control tower
 - (xv) Outlet gates
 - (xvi) Toe of earth dam downstream drainage arrangements and beams
 - (xvii) All saddle dams
- (d) What is the general condition of all the structures on various access roads?

Are all the structures on the access roads adequately safe, for allowing passage of plant machinery for emergent repairs?

17. Communication facilities

- (a) Are following facilities available at dam site?
- (i) Wireless
 - (ii) Telephone
 - (iii) Telegraph

18. General assessment of condition of the dam

Please give general assessment of safety of dam for normal operation. Please enumerate all your observations which you feel are adverse to the safety of the dam for normal operation.