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I A HYDRO ENERGY PRIVATE LIMITED

Chanju-I (12X3 MW) Hydro Electric Project

Himachal Pradesh

BARRAGE OPERATIONAL & MAINTENANCE MANUAL 2022-2023

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Chanju-I Hydro Electric Power Plant

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1. INTRODUCTION

Chanju-I HEP has been envisaged as a run-of river scheme on Chanju Nallah, a tributary of Baira River which in turn drains into the river Ravi, in Chamba Distt. HP. The scheme is located upstream of the exiting Baira Suil HEP (198 MW). The nearest rail head is at Pathankot about 120 Km from Chamba Town. The project is located on Chamba –kathwar road at about 77 Km from Chamba town. The project involves the construction of a gated weir across the Chanju Nallah at about 100 m downstream of the confluence of the Chanju nallah & the Bhararu nallah. The water conductor system comprises twin side intakes, twin feeder tunnels, twin desilting basins, twin connecting tunnels, a 4.40 km long & 3.2m dia D-shaped concrete lined Head Race Tunnel, 540m long & 3.4m diacircular-shaped reinforced concrete tunnel & steel lined pressure tunnel 748m long & 2.3m dia, 528m long & 3.2 x 3.6m dia D-shaped Surge gallery, 1m in 11.8m slope in which 377 m concrete lined. Three number unit penstock bifurcates near Power House, feeding three Francis Turbines, each of 12 MW. A 41m long Tail Race Tunnel conveys the water to an Outfall Structure through which the water is finally discharged into Chanju Nallah. A 132 kV Surface Switchyard is constructed on u/s of Power House.

The project will be able to generate 157.85 GWh of energy at the Power House bus bar in 90% dependable year at 95% machine availability. The power generated is injected Kurthla-Bathri through 132 kV D/C line by LILO arrangement.

The Chanju Nallah, a tributary of Baira Nallah and a sub-tributary of river Ravi. Chanju Nallah consists of four Nallah viz. Tanger Nallah, Diyothal Nallah, Mehad Nallah and Bhararu Nallah. Bhararu Nallah consists of four Nallahs viz. Nakal Nallah, Panglod Nallah, Juri Nallah and Ganj Nallah. The catchment of Chanju nallah is very rugged and hilly and lies in elevation below the range of 5400m. The shape of catchment is an elongated leaf shape. The catchment area above the proposed diversion site measures 307 km^2. The snow bound catchment area above elevation 4000m is about 67 km^2, about 22% of the total catchment area.

The perception in the catchment takes place in the form of snow and rain. The Chanju nallah receives runoff contribution from rain, snow and glaciers. The contribution from different sources and their temporal distribution make this nallah perennial in nature. The catchment receives heavy rains during monsoon months i.e. from June to September, which occasionally extends up to early October due to the south-west monsoon. Rainfall is very scanty during the winter and spring seasons (October to March) which is generally due to the western disturbances that pass over the north-West part of the country and falls in the form of snow. The winter precipitation does not increase the stream flow significantly during the winter months but monsoon is a major contributor for increased flow during summer months due to snow melting.

2. General Description of Dam

1. Location

State	:	Himachal Pradesh
District	:	Chamba
River/Stream	:	Chanju Nallah, a tributary of Baira Nallah and a sub-tributary of river Ravi.
Vicinity	:	Diversion weir on Chanju Nallah at about 100m downstream of Bhararu Nallah confluence and Power House on the right bank.

2. Geographical Co-ordinates of Project Area

Longitude	:	76°14'52"E
Latitude	:	32°44'14"N
Seismic Zone	:	**V**

Access distance from

New Delhi	:	670 km
State Capital Shimla	:	378 km
District Head Quarter, Chamba	:	70 km
Nearest Rail Head, Pathankot	:	197 km
Nearest Airport, Pathankot	:	197 km

3. Diversion Structure

Type	:	Gated weir (Barrage)
Average River Bed Level	:	El. 1426.00 m
Crest Level of Barrage Bays	:	El. 1427.00 m
Crest Level of Sluice Bay		El. 1426.00 m

	Bridge Deck Level	:	El. 1442.00 m

4. Barrage Bays

No. of bays	:	4
Width of each Bay	:	6.5 m
Thickness of Piers	:	2.0 m
Clear width of Barrage Bays	:	26 m
Type and Height of Gate	:	Radial gate, 7.0 m

5. Under Sluice Bays

No. of under sluice bays	:	1
Width of each Bay	:	6.5 m
Thickness of Pier	:	2.0 m
Crest Level of Under Sluice Bays	:	El. 1426.00 m
Clear Width of under sluice portion	:	6.5 m
Type and Height of gate	:	Radial Gate, 7.0 m high

6. Reservoir

Full Reservoir Level (FRL)	:	El. 1440.00 m
Minimum Draw Down Level (MDDL)	:	El. 1432.75 m
Live Storage	:	60000 m^3

7.	**Energy Dissipation System**	:	Hydraulic Jump Type Stilling Basin
	Length of basin	:	47.5 m
	Width of basin	:	39.5 m
	D/s Floor Level	:	El. 1423.00 m

8. Power Intake

Type	:	Side Intake
No. of intakes	:	1
Size of Intake	:	2 bays each, vertical lift gate 1.90 m wide & 3.50 m high 3.75 m width 1.5 thick pier.
Invert Level of Intake	:	El. 1426.00 m
Top Lip Level	:	El. 1429.00 m
Minimum Draw Down Level (MDDL)	:	El. 1432.75 m
Design Discharge including 20% for sediment flushing.	:	16.85 x 1.2 = 20.22 m^3/s

9. Feeder Tunnels

Number	:	2
Design Discharge in each Feeder Tunnel	:	10.11 m^3/s
Type	:	D shaped (4.5 m X 3.5 m) with middle wall
Length of main twin Feeder tunnel	:	126 m

10. Desilting Chamber

Type	:	Underground hopper type
Number of Basins	:	2 Nos.
Size	:	B = 9.25 m
		D = 9.0 m
		L = 83.0 m
Side Slope of Hopper	:	1H : 1V
Average Discharge for each Basin	:	9.27 m^3/s

Average Flow-through velocity	:	0.16 m/s
Flushing Arrangement	:	Two no's of 0.7m dia flushing pipes.
Flushing velocity	:	> 5 m/s

11. Connecting Tunnels

Type	:	D-shaped, Concrete lined
Size	:	3.2 m x 3.2 m
Length	:	41.0 m and 50.5m

12. Head Race Tunnel

Type	:	D-shaped, concrete lined
Size	:	3.2 m x 3.2 m
Total Length (a)	:	4040.0 m
Type	:	Circular-shaped, reinforced concrete lined
Size	:	3.4m dia
Total Length (b)	:	540.0 m
Type	:	Steel lined pressure tunnel
Size	:	2.3 m dia
Total Length (c)	:	748m
Total length of water conductor system (a+b+c)	:	5328m

3. Assignment of Responsibilities:

Sr. No.	Function	Officers having responsibility
1.	Project Administration	Project Head/Consultant
2.	Operation of equipment at the Barrage	Barrage Incharge
3.	Recording reservoir data	Shift Incharge
4.	Routine Inspection	Shift Incharge, Electrician
5.	Weekly Inspection	Barrage Incharge, Civil Engineer
6.	Maintenance	Barrage Incharge, maintenance team

4. Collecting and Reporting of Barrage and Reservoir Data:

Routine data for the following is to be recorded:

- Barrage level data is to be recorded after the 15 minutes interval regularly and recorded on Barrage Shift register.
- Operation of gates and desilting valves are also in record on Barrage Shift register.
- 15% of average lean period discharge is shown regularly on hppcblivedata.com site.

5. Public Utility and Safety:

Inconformity to the public safety norms signboards are provided at the downstream and near by the path for the safety of the people and also two hooters are installed to alert the people at the time of water discharge from the Barrage. Also every year announcement work carried out to aware people in entire project area before the starting of rainy season when water level raised and water discharge is required.

Nearest Primary health care is at Bagheigarh which is at about 05 KM from the Barrage Site and nearest Police Station is at Nakror which is about 18 KM from Barrage Site.

The following safety equipment are available at Barrage Site:

1. Safety helmets.
2. First Aid Kit.

6. Restricted Areas

Restricted areas of I.A Hydro Energy Private Limited Chanju-I HEP Barrage Site are:

1. Intake gates.
2. Radial gates power pack
3. Silt flushing tunnel
4. GOC.

7. Communication System:

We are using communication system with well communicated three tire system i.e. mobile, wireless and intercom. All the officers of the Project are also connected through Whatsapp group also. Hence any unusual development in the project is communicated to the highest level with immediate effect and appropriate action is taken.

Our Barrage is situated at the confluence, Chanju & Bhararu Nallahs. In order to safeguard permanent structures of the project against exceptional floods, flood warning system i.e. one check post has been installed at Charda along the upstream of Barrage & One check post has been installed at Jhakla about 04 KM upstream of Barrage Site to safe guard the project component & for the safety of man & machinery employed at the project site having telecommunication & wireless system which would also help in timely warning regarding impending flood.

However in case of flood or Barrage failure EAP is prepared every year and Project Head of IA Hydro Energy will be responsible and ensure over all activities in coordinated manner to inform the nearby Police Station and downstream projects and civil administration. The list of the concerned person telephone number is displayed in Barrage control room and Power house control room and as well as Project Head office.

The proper accessibility with motorable road has been ensured to the Barrage site for constant monitoring during emergent situations and we used to keep two vehicle ready for incidents response Mahindra Bolero V.No. HP 44 3235 and Ambulance HP 73 2311.

8. Data of Historic Floods:

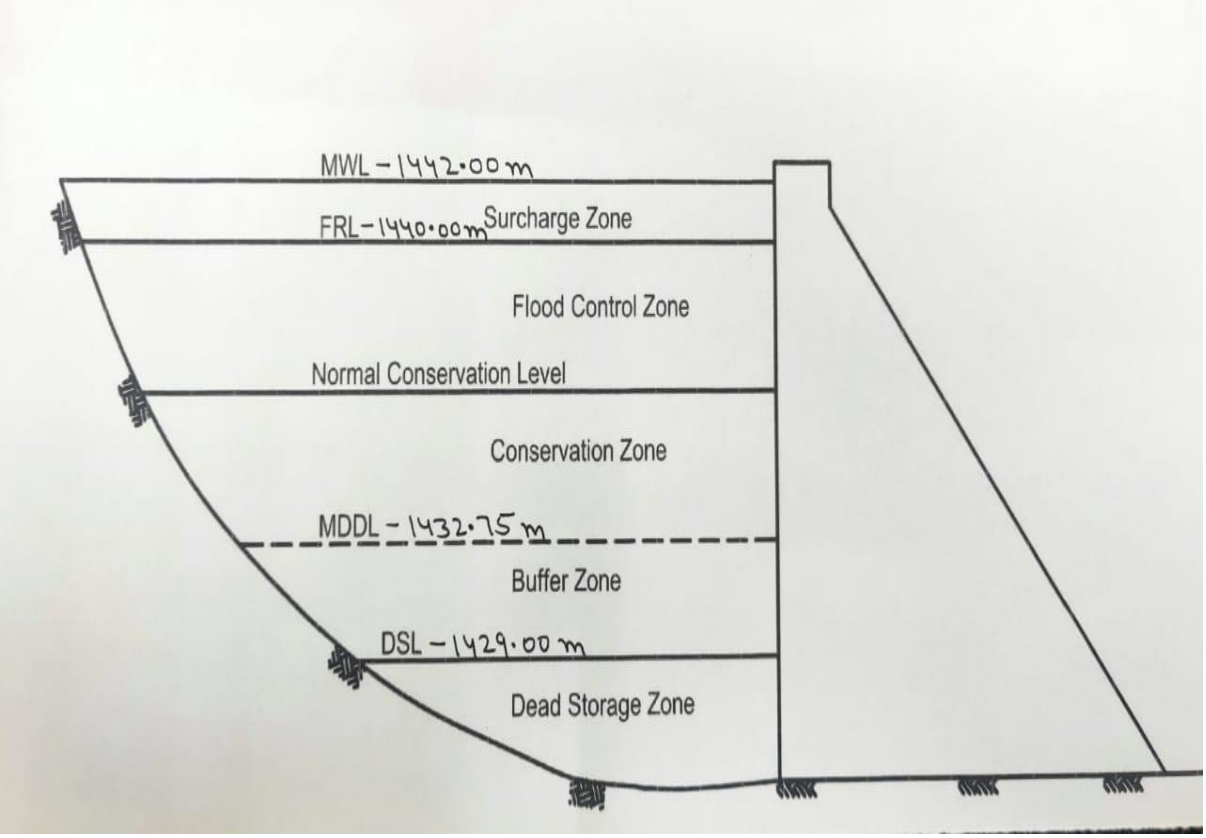
The project was completed in the year of 2016 and till now there is no severe flood hit in our region. During the rainy season. We generally receive 20% of excess water as per our design discharge and the same used to be released through Barrage Radial gates till now.

9. Operation Plan:

The operation of the barrage includes observation of reservoir levels, keeping records and ensuring both dam and public safety. This Manual covers the normal operation procedures to be followed during both monsoon and non-monsoon. Special operational procedures are to be followed during an emergency situation as per the Emergency Action Plan.
Proper communication and information is provided for the downstream inhabitants regarding discharge of flood water through the gates when there is a forecast of heavy rain fall in catchment areas.
All the gates and hoists of the head regulator are inspected daily during the monsoon season for its proper functioning and lubrication and other fault if found are set right as soon as possible.

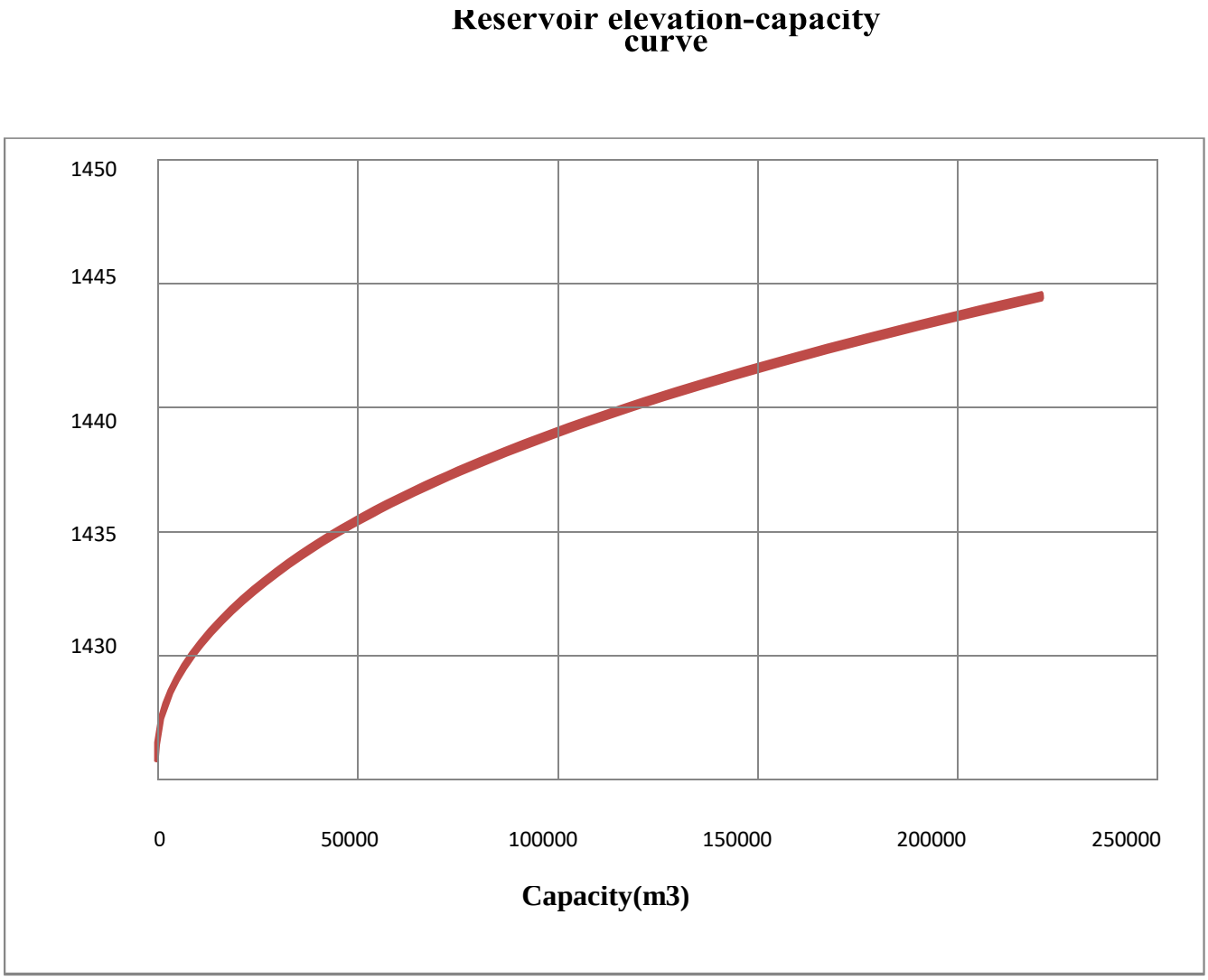
10. Reservoir Capacity:

The storage capacity of reservoir is conceptually divided into a number of zone based on the useful purposes that a reservoir is required to serve. Dead storage zone is the bottom most zone of reservoir. Major storage zone is occupied by the conservative zone. If the reservoir is operated to control floods then the flood control storage is provided above the conservation zone followed by the surcharges storage. The reservoir capacity used to be reduced with time because of the sedimentation due to flash floods etc. due to muddy water when the discharge increases in the river.



Reservoir storage allocation zone

11. Reservoir Area Capacity curve



12. Normal Operational Procedure:

The operating procedures developed for normal or ―day-to-day operation of the Barrage includes the anticipation of water inflow and also release of 15% of average lean period discharge which is passed through fish ladder and in case if the water level increases above the FRL then the water is released through Radial gates.

12.1 RADIAL GATES OPENING PROCEDURE:

Surplus water during floods is released through Barrage Sluice and Radial Gates. The gate operation schedule for passing flood safely must be prepared based on the project layout and the result of hydraulic model studies. The following guidelines may be borne in mind while preparing the gate operation schedule:

- The regulation of gates should be based on model studies where such studies have been carried out. Otherwise the regulation can be based on past experience of operation of the gates and design studies carried out for developing the same. The aim will be to ensure safety of the dam structure including the gate components, hoists, energy dissipation arrangement and downstream channel while letting out the desired discharge.
- The end gates shall normally be opened first to prevent cross-flows striking against the walls and junctions.
- At any time during the operation of different gates, the difference in gate opening of any two consecutive bays should not exceed 0.5 meters.
- After opening the end gates, the gates at the centre should be opened and the other gates should be opened in symmetrical manner starting from the centre towards the end through gradual increase in the openings.
- While closing the gates, the gate that was opened last should be closed first. The procedure to be followed for closing the gates should be generally reverse of the procedure followed for opening the gates. Complete closure of the gates should be accomplished by gradual lowering of the gates by 0.2 to 0.3 m in the proper sequence.

12.2 OPERATIONAL PROCEDURE FOR SLUICE AND BARRAGE RADIAL GATES

(A) When the river inflow is less than of 20 cumecs:-

- Maintain the reservoir level between El. 1439.50m and El. 1440.00m if the discharge is more than 19 cumecs maintain the reservoir level El. 1438.00 m.
- In the case of sudden closure of Power House, release the excess discharge through Sluice and Radial Gates.

(B) When the river inflow is between 20 cumecs and 30 cumecs:-

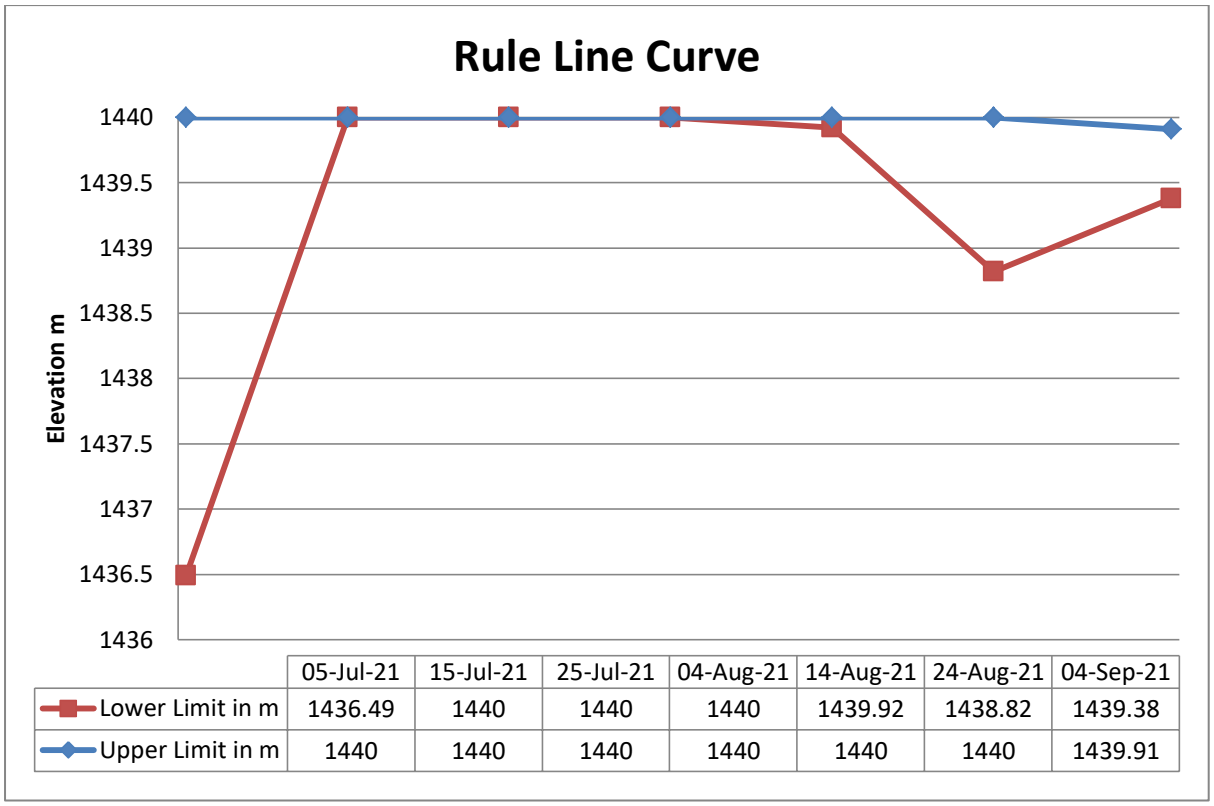
- Maintain the reservoir level between El. 1438.00m and El.1439.00m.
- Release excess discharge through Sluice radial gate in order to flush out silt in front of Intake gate.
- If the discharge appears to be higher through the under-sluice gate, Radial Gate No. 5 used to be opened, and then Gate No. 2 & 4 and at the last gate no.3.

(C) When the river inflow is very high (flood conditions) cumecs: -

- Gradually start depletion of reservoir level by opening Radial gates.
- End Radial gate shall be operated first. It shall be initially raised / opened partially (minimum 10% of total opening height). If this opening is not sufficient to pass the surplus discharge, centre gate shall be opened. And if required other gates shall be opened in symmetrical manner.

13. Release of Surplus water

If reservoir level tends to be increasing above FRL then the Sluice and Radial gate shall be continuously opened by issuing warning by sirens and wireless messages to all the concerned authorities.



	05-Jul-21	15-Jul-21	25-Jul-21	04-Aug-21	14-Aug-21	24-Aug-21	04-Sep-21
Lower Limit in m	1436.49	1440	1440	1440	1439.92	1438.82	1439.38
Upper Limit in m	1440	1440	1440	1440	1440	1440	1439.91

14. Operation Manual of Radial Gates

Gates opening and closing are performed by the action of the hydraulic cylinders.
Control of operations will be done from the local control panel and barrage control room. Provisions have also been done to operate and transmit indicating signals to the Power House Control Room.

14.1 Normal Operation

The operations can be stopped at any instant by pressing the "PB1" push button located on the electrical control panel.

- Selector "S1" LOCAL/REMOTE must be on LOCAL.
- Selector "S2" LOCAL- MAINTENANCE/ AUTO/ EMERGENCY SEL. must be on either LOCAL MAINTENANCE or AUTO.
- Selector "S3" SINGLE GATE/ TWO GATE to be on selected per site requirement. Two gates (adjacent) can be operated simultaneously by using one electric pump but at half speed.
- Selector "S4" WORKING/ STAND-BY MOTOR to be selected suitably.

AUTO – in this mode, gate position is monitored for creeping. If gate creeps more than 150mm, Motor will be automatically switched on and gate will automatically reached to earlier set position.

Closing procedure

a) Press the gate closing push button "PB5/ PB7" (CLOSE);
b) The cylinder operates the stroke to intermediate or fully close the gate.

Opening procedure

a) Press the gate opening push button "PB4/ PB6" (OPEN);
b) The cylinder operates the stroke to intermediate or fully open the gate.

Normal operation can also be done by manual control (selector "S2" in MAINTENANCE position) during the functioning tests.

The LOCAL (MAINTENANCE) operation through selector "S2" can be used to start the pumps alone, without moving the gates, for motors and pumps testing purpose.

14.2 Manual Operation (Hand Pump Unit)

Manual operation with hand pump unit is possible in case of power failure.

Closing procedure (by gravity without hand pump) (stroke must be continuously checked on position indicator)

a) Actuate and lock the solenoid-valve “CETOP 5 & CETOP 3” to intermediate or fully close the gate;

b) When the gate is at the desired position, unlock the solenoid-valve “CETOP 5 & CETOP 3”

Opening procedure

a) Actuate and lock the solenoid-valve “CETOP 5 & CETOP 3” to intermediate or fully close the gate;

b) Operate the hand pump to open the gate at the desired position. (Stroke must be continuously checked on position indicator)

c) When the gate is at the desired position, unlock the solenoid-valve “CETOP 5 & CETOP 3”

15. Operation Manual for Intake Fixed wheel gate

Gate opening and closing are performed by the action of rope drum hoists.
Control of operations will be done from the local control panel and barrage control room.
Provisions have also been done to control and transmit indicating signals to the Power House Control Room.

WARNING: Opening (raising) of the gate shall be only done under balanced water pressure conditions.
Opening shall be possible only with the tunnel filled and pressurized by means of the crack opening.
Under normal operation the gate should not be in intermediate position.

15.1 Normal Operation

The operations can be stopped at any instant by pressing the "STOP" push button located on the push button pendant.

Closing procedure

a) Press the "START" button
b) Press the gate closing push button "DOWN" (CLOSE);

*DOWN button to be continuously be pressed and shall be released at required position.

Opening procedure

a) Press the "START" button
b) Press the gate closing push button "UP" (OPEN);

*UP button to be continuously be pressed and shall be released at required position.

15.2 Manual Operation

Manual operation with hand lever unit is possible in case of power failure.

WARNING: "Emergency STOP" button shall always be engaged before performing manual operation using hand lever.

a) Engage the dog-clutch to motor shaft.
b) Both the brakes to be manual release.
c) Gate to be open/close manually by rotating the hand lever.

At the end of manual operation, all original conditions shall be restored.
After manual operation, gate to restored to any of its extreme positions and position transducer to be reset at that position.

16 Emergency Operation:

The emergency operation will be carried out following the Emergency Action Plan (EAP). The EAP together with this manual will be present at the site at all times.

Record Keeping:

- Reservoir level on daily basis recorded in shift register after 15 minutes interval.
- Gate opening and closing also recorded in shift register.
- Rainfall recorded throughout the year.
- Weekly inspection.
- Record of the annual maintenance.
- All operating procedures.

17. PROJECT INSPECTION

An effective inspection program is essential to identify problems and to keep a dam in a good and healthy condition.

17.1 TYPE OF INSPECTION

Four different types of dam safety inspections are carried out at IAHEPL Barrage:
1. Informal inspection.
2. Scheduled inspection (Pre & Post monsoon inspections & other scheduled inspections)
3. Special (unscheduled) inspection.
4. Comprehensive evaluation inspection.

1. INFORMAL INSPECTION

An informal inspection is a continuing effort by on-site personnel (dam owners/operators and maintenance personnel) performed during their normal duties. Informal inspections envisage surveillance of the dam periodically and are critical to the proper operation and maintenance of the dam. They consist of frequent observations of the general appearance and functioning of the dam and its components. In IAHEPL we conduct informal inspection weekly where we inspect the Barrage components.

2. SCHEDULED INSPECTION

Scheduled inspections shall consist of Pre monsoon & Post-monsoon inspection and any other inspections carried out by the State Dam Safety Organization constituted by the dam owner. These inspections are performed to gather information on the current condition of the dam and its appurtenant works. This information is then used to establish needed repairs and repair schedules, and to assess the safety and operational adequacy of the dam. Scheduled inspections are also performed to evaluate previous repairs. The purpose of scheduled inspections is to keep the dam and its appurtenant structures in good operating condition and to maintain a safe structure.

3. SPECIAL INSPECTION

Special inspections may need to be performed to resolve specific concerns or conditions at the site on an unscheduled basis. Special inspections are not regularly scheduled activities, but are usually made before or immediately after the dam or appurtenant works have been subjected to unusual events or conditions, such as an unusually high flood or a significant earthquake. The system envisages a quick check within 1 hour after the earthquake event, next i.e. first check within 3 hours and a second check within 24 hrs.

4. COMPREHENSIVE EVALUATION INSPECTION

For comprehensive dam safety evaluation for each dam an independent panel of experts known as Dam Safety Review Panel (DSRP) needs to be constituted for determining the condition of the dam and appurtenant works. The panel would undertake evaluation of each dam once in 10 years or on occurrence of any extreme hydrological or seismic event or any

unusual condition of the dam or in the reservoir rim. The terms of reference of the comprehensive dam safety evaluation shall include but not be limited to:

1. General assessment of hydrologic and hydraulic conditions, review of design flood, flood routing for revised design flood and mitigation measures.

2. Review and analysis of available data of dam design including seismic safety, construction, operation maintenance and performance of dam structure and appurtenant works.

3. Evaluation of procedures for operation, maintenance and inspection of dam and to suggest improvements / modifications.

4. Evaluation of any possible hazardous threat to the dam structure such as dam abutment slope stability failure or slope failures along the reservoir periphery.

18. PROJECT MAINTENANCE

A good maintenance program is required to protect a dam against deterioration, prolong its life and reduce the chances of failure. Maintenance program for a dam should be developed primarily based on systematic and frequent inspections. Nearly all the components of a dam and its materials are susceptible to damage and deterioration if not well maintained. Moreover, the cost of a proper maintenance is small compared to the costs of major repairs, loss of life, property and litigation. If maintenance of a dam is neglected theconsequences and costs could be enormous.

19. MAINTENANCE PRIORITIES

Maintenance activities need to be prioritized. In order of priority they need to be clarified under the heads immediate maintenance & preventive maintenance.

19.1 IMMEDIATE MAINTENANCE

The following conditions are critical and call for immediate attention & reservoir lowering, if warranted. These conditions are:

- The dam is about to be overtopped or being overtopped during high flood.
- The dam is about to be breached by erosion, slope failure etc.
- A dam showing signs of failure due to aging/cracking, sliding, overturningetc.
- The dam showing signs of piping or internal erosion along shear zones, faults indicated by increasingly cloudy seepage or other symptoms.
- The spillway being blocked or with some inoperable gates.
- Evidence of excessive seepage as on downstream face of the dam.

An EAP is to be activated when any of the above conditions are noted.

19.2 PREVENTIVE MAINTENANCE

This can be classified as Condition based Maintenance and Routine Maintenance.

19.3 CONDITION BASED MAINTENANCE

The following maintenance works are to be undertaken as soon as possible after the defective condition is noted. These include but are not limited to:

- Remove all vegetation and bushes by roots from the dam surface and restoring any eroded areas.
- Repair any concrete or metal components that have deteriorated.
- Cleaning of the choked drainage holes in the Barrage body/ foundations.
- Repair any damages on spillway glacis, piers, energy dissipaters, divide walls, downstream areas etc.
- Controlling any heavy seepage in the foundation.
- Repairs of any cracks/cavities/joints in concrete structures.

However many of these works will require the services of experienced engineers/expert panels.

19.4 ROUTINE MAINTENANCE

Several tasks should be performed on a continuous basis. These include but are not limited to the following:

- Any routine repair to concrete or metal component.
- Observation of any springs or seepage areas, comparing the quantity and quality (clarity) with earlier observations.
- Monitoring of downstream development which could have an impact on the barrage and its hazard category.
- Maintenance of Electrical & Hydro-Mechanical equipment and systems e. g. Servicing of spillway gates, hoisting arrangements and gates/hoist of outlet works & stand by generator.
- Maintaining proper lighting at Barrage top etc.
- Monitoring/ cleaning & removal of leached deposits in porous concrete / formed drains in Barrage body.
- Maintenance of all Barrage roads & access roads.
- Operation of electrical and mechanical equipment and systems includinggates & valves.
- To keep the gate slots clear of silt/debris.
- Maintenance/testing of monitoring equipment (instruments) and safety alarms.
- Testing of security equipment.
- Testing of communication equipment.
- Any other maintenance considered necessary.

20. MAINTENANCE ITEMS

20.1 Gates & Hoisting Equipment

The safe and satisfactory operation of Spillway depends on proper operation of its Gates & Hoisting Equipment. Maintaining spillway gates in working condition is critical for dam safety and is to be assigned the highest priority. If routine inspection of the Hydro-Mechanical Equipment reports the need for maintenance, the work should be completed as soon as possible.

The gates are to be operated through their full range twice annually. As operating gates under full reservoir pressure can result in large discharges, exercising of gates should preferably be carried out during dry conditions or lean times of the year. The aspects to be inspected and maintained periodically for ensuring proper operation of gates in general are given below. The O&M manuals of the gates manufacturer's would however govern the overall maintenance of Gate and Hoists whenever there is any contradiction with the inspections given in the Manual.

i) The gate slot and bottom platform/sill beam should be cleaned periodically. Scales formed over the embedded parts should be removed. Second-stage concrete should be checked for any development of cracks / leakages and repairs should be attended to immediately.
ii) The gate leaf should be thoroughly cleaned and repainted as and when necessary according to the procedure as per the recommendations of the paint manufacturer.
iii) Rubber seals should be smoothened, if required, for proper alignment. All nuts and bolts fixing the seal to the gate should be tightened uniformly to required torques. Seals, if found damaged or found leaking excessively should be adjusted, repaired or replaced as considered necessary.
iv) The wheel shall be rotated to check their free movement. Gate roller bearings and guide roller bushes should be properly lubricated. Whenever necessary these should be opened for rectifications of defects, cleaning and lubrication and should thereafter be refitted. These may be replaced if repairsare not possible.
v) All nuts, bolts, check nuts and cotter pins of the lifting devices should be checked periodically.
vi) All components should be greased and lubricated. Recommended and approved oils and grease only should be used.
vii) All welds shall be checked for cracks/ damages. Any weld that might have become defective should be chipped out and redone following the relevant codal provisions. Damaged nuts, bolts, rivets, screws etc. should be replaced without delay.
viii) The guide-assemblies, wheel-assemblies and sealing-assemblies shall be cleared off grit, sand or any other foreign material.
ix) The wheel pin shall be coated with corrosion resistant compound.
x) All nuts and bolts shall be tightened.

The other aspects to be inspected and maintained periodically for ensuring proper operation of these gates are as under:

a) Rubber Seals:

Seals shall be inspected for leakages. Locations of excessive leakages shall be recorded for taking remedial measures. Appropriate action to replace the damaged seal needs to be

taken immediately after monsoon. Weeping or slight flow in localized area will not require immediate remedial measures. However, measures like tightening of bolts are carried out. Further adjustment is carried out during annual maintenance.

b) Trunnion block assembly and anchors:

All the nuts and bolts of Trunnion block assembly and its anchorages shall be checked for tightness.

i) Check all the welds for soundness and rectify defects.

ii) Check whether the Yoke girder and thrust block is covered or not. If not, cover it with mild steel plates.

iii) Cover the trunnion pin with anti- corrosive jelly.

iv) Remove all dirt, grit etc. from trunnion assembly and lubricate trunnion bearings of the gate with suitable water resisting grease as recommended by bearing manufacturers.

c) Gate structures:

i) Check all the welds for soundness and rectify defects.

ii) Check welds between arms and horizontal girders as well as between latching bracket and skin plate with the help of magnifying glass for cracks/defects and rectify the defects.

iii) Check all the nuts and bolts and tighten them. Replace damaged ones.

iv) Corroded surface shall be cleaned and painted.

d) Embedded Parts:

i) All the sill beams and wall plates shall be inspected for crack, pitting etc. and defects shall be rectified. The guide roller pins shall be lubricated.

e) General Maintenance:

Defective welding should be chipped out and it should be re-welded duly following:

- Damaged nuts, bolts, rivets, screws etc. should be replaced.
- Any pitting should be filled up by welding and finished by grinding if necessary.
- The gate leaf, exposed embedded metal parts, hoists and hoist supporting structure etc., should be thoroughly cleaned and repainted when required.
- Bolts and trunnion bearing housing should be tightened wherever required.
- The seals of the gate should be checked for wear and tear and deterioration. These should be adjusted/replaced as and when necessary.
- The wall plates, sill beams shall be checked and repaired if necessary
- Wire ropes should be properly lubricated.
- Maintenance of alternative sources of Power such as Diesel Generating sets.
- The list of essential spare parts to be kept available should be reviewed and updated periodically. The condition of spares should be checked periodically and

protective coating given for use. Ensure availability of essential spare parts at site as per the list of essential spares.

20.2 Maintenance of Electrically operated fixed hoists

i) General Instructions:

a) Operation of fixed hoist without lifting the gate is not possible and need not therefore be attempted. It will be possible to operate the unit and observe operation of load carrying hoist component when gate is being lifted or lowered.

b) Never open any bolt or nut on motor, gear boxes, rope drums and other load carrying hoist components when the gate is in raised position. The gate should be fully closed or rested on the gate latches before carrying out any work on hoist components including motor brake and other electrical equipment.

Inspection and Maintenance

The aspects to be inspected and maintained periodically for ensuring proper operation of Rope drum hoists are as under.

i. A cursory daily inspection shall be made of hoist and gate to ensure that there is no unusual happening.

ii. Clean all hoisting equipment and hoist platform.

iii. Check oil level in gearboxes and replenish as and when required with oil of proper grade.

iv. Apply grease of suitable grade by grease gun.

v. Lubricate all bearings, bushings, pins, linkages etc.

vi. Check all the fuses on the power lines.

vii. All bolts and nuts on gear boxes, hoist drum and shaft couplings should be checked for tightness.

viii. Check the supply voltage.

ix. All the geared couplings shall be greased.

x. Raise and lower the gate by hoist motor and check for smooth, and trouble free operation of gate without excessive vibration.

xi. Observe current drawn by motor at the time of lifting and check if it is more than normal. If so, stop the hoist and investigate the cause andrectify.

xii. Check the condition of painting of various components and remove rust wherever noticed and repaint the portion after proper cleaning as per painting schedule.

xiii. All trash, sediments and any other foreign material shall be cleared off the lifting rope and lifting attachment.

xiv. All ropes shall be checked for wear and tear and if broken wires are noticed, the rope shall be replaced.

xv. All wire ropes shall be greased with cardium compound.

xvi. Check the overload relays for proper functioning.

xvii. Check all the nuts, bolts, rivets, welds and structural components for

hoisting platform and its supporting structure for wear, tear and damage. All damages shall be rectified.

xviii. All bolts shall be tightened. The portion withdamaged painting shall be touched up.

xix. Check the pulleys, sheaves and turn-buckles. Adjust the rope tension of wires if unequal.

xx. Check for all gears and pinions for uneven wear and adjust for proper contact. Grease the gears.

xxi. Repaint the hoist components, hoisting platform and its supporting structures as per requirement.

xxii. The periodic maintenance of commercial equipment like motors, brakes, thrusts etc. shall be carried out as per manufacturers operation and maintenance manual.

xxiii. Raise and lower the gate for its full lift several times (at least three to four) and observe the following:

a) Check the limit switches and adjust for design limits.

b) The effectiveness and slip of the brakes shall be checked by stopping the gate in raising and lowering operations. The brakes shall be adjusted if needed.

c) When the gate is operated, there should not be any noise or chatter in the gears.

20.3 Maintenance of Electrical components of Fixed Rope Drum Hoists

a) The Electrical components to be inspected and maintained periodically are as under;

i) Starters should be cleaned free of moisture and dust.

ii) Each individual contactor should be tried by hand to make sure that it operates freely.

iii) All wearing parts should be examined in order to take note of any wear which may have occurred during operation.

iv) If the contactor hums, the contact faces should be cleaned.

v) Examine earth connections and motor leads.

vi) Examine control equipment

vii) Examine starting equipment for burnt contacts

viii) Check and tighten all nuts and bolts

ix) Clean and tighten all terminals and screw connections all contact surfacesshall be made clean and smooth.

x) Lubricate the bearings.

xi) Overhaul the controllers.

xii) Inspect and clean circuit breakers.

20.4 Electrical System

Electricity is typically used at a dam for lighting and to operate the gates, hoists, recording equipment, and other miscellaneous equipment. It is important that the Electrical system be well maintained, including a thorough check of fuses and a test of the system to ensure that all parts are properly functioning. The system should be free from moisture and dirt, and wiring should be checked for corrosion and mineral deposits.

All the motors, brake system, control panel and limit switches shall be overhauled once in every year preferably before monsoon, and after monsoon. All the components shallbe checked in detail for the electrical parameters. If any components are seen damaged shall be repaired/ replaced so as to ensure smooth operation of the equipment. The bearings of electric motor should be grease lubricated once in six months.

All necessary repairs should be carried out immediately and records of the works kept. Maintain generators used for auxiliary emergency power – change the oil, check the batteries and antifreeze and make sure fuel is readily available. Monitoring devices usually do not need routine maintenance. Open areas are particularly susceptible to vandalism. As such all electrical fittings like bulbs, lights, loose wires etc. in open areas should be checked routinely and replaced/repaired where needed.

20.5 Stop logs for Radial gates

IAHEPL has two sets of stop logs for Radial Gates. These stop logs shall be operated under balanced head conditions (both for raising & lowering) by Gantry Crane to be located at the top of dam over the rails fixed on the roadway over the dam with the provision of an automatic engaging & disengaging lifting beam. The following aspects are to be considered and attended during maintenance:

- Defective/damaged/cracked welding should be chipped out and rewelded.
- Damaged nuts, bolts, screws etc. should be replaced.
- The gate leaf should be thoroughly cleaned and repainted whenever necessary.
- Rubber seals should be grinded, if required to bring it in alignment. All nuts and bolts for fixing seals to gate should be tightened uniformly. Seals when damaged or found leaking excessively should be adjusted or replaced as and when considered necessary.
- All components should be greased and lubricated with the recommended oil and grease only.
- The roller assembly should be adjusted by the eccentricity provision to ensure that all the rollers rest uniformly on track plates particularly in the closed position of the stop log gate.
- The drain holes in horizontal girders should be cleaned.
- The gate slots should be kept cleaned. The scaling over the embedded parts should be removed.

20.6 Lifting Beams

Lifting beam shall be used for both raising & lowering of Spillway stop log units with the use of Gantry crane. Lifting Beam shall mainly comprise of two number structural steel channels or fabricated channels with back to back connection to make it a single fabricated structural frame. Two side guide rollers/shoes shall be provided on each side of the lifting beam. The depth of lifting beam/frame should be sufficient to accommodate to rollers on each side located at sufficient distance from one another to enable proper guided movement. Following issues need to be considered and attended during maintenance:

- Bush bearing of lifting attachment and various pulleys/sheaves wheel gears etc. should be properly lubricated.
- Whenever it is felt that friction in the bearing has increased, these should be taken out for cleaning and lubrication and should be refitted properly. These should be replaced, if found beyond repair.

20.7 Gantry Cranes

Hoisting trolley of the Gantry Cranes are generally built on top of a wheeled mobile gantry structure travelling over fixed rails and is used to straddle an object or load over a workspace. The major component parts of the gantry comprise of the following: Frame & legs, machinery housing, operator‘s cabin, walkways, ladders and railings, end buffers, mechanical equipment, wheels and axles, gantry drive unit, wire rope, rope drum, gears and pinions, reduction gear box, shafts for gears and pinions, sheaves and pulleys, bearings, flexible couplings, lifting hook and block, sockets for wire ropes, gear box covers, keys & key ways, counter weight, wrenches and tools, electrical equipment, electric motor, master control equipment, cables and cable reel, wiring ,limit switches, miscellaneous components etc. Following aspects need to be considered and attended to during maintenance:

- The insulation resistance of motor winding. In case it is found to have dropped below a prescribed value, the motor should be dried prior to putting back in service. If weak insulation becomes a regular feature, the winding should be given a good coat of insulating varnish after the motor has been dried.
- Checking of all the electrical connections.
- Lubrication of each part of crane.
- Removal of any loose/foreign material along the rail track
- Actuating tests of limit switches
- Actuating tests of brakes.
- All fuses in the control panel should be checked and if necessary it should be replaced.
- Necessary terminal connections of motors, brakes etc. is to be checked.
- Overload relay should be checked.
- Visual inspection of wire ropes for any snapped loose wire and its proper lubrication.
- Checking of rope clamps on the drum and tightening of bolts if required.
- Gearbox assembly should not have any leakage of oil.
- Unusual noise/vibration if any should be checked and rectified before operation

20.8 Access Roads

For a Barrage to be operated and maintained there must be a safe means of access to it at all times. Access road surfaces must be maintained to allow safe passage of automobiles and any required equipment for servicing the dam in any weather conditions. Routine observations of any cut and fill slopes along the sides of the road should be made. If unstable conditions / slope failure etc. develop, assistance of experienced Engineers/Expert Panels should be arranged and remedial measures initiated. Drains are required to be provided and maintained along roads to remove surface and subsurface drainage. This will prolong the life of the road and help reduce deterioration from rutting.

21. Maintenance Records

Maintenance records are of utmost importance. A record should be kept of all maintenance activities, both immediate and preventive maintenance works. Information that should be recorded includes the following as a minimum:

- Date and time of maintenance.
- Weather conditions.
- The type of maintenance.
- Name of person or contractor performing maintenance.
- Description of work performed.
- The length of time it took to complete the work with dates.
- Equipment and materials used.

22. INSTRUMENTATION AND MONITORING

Water Level

For Barrage, it is important to monitor the water level in the reservoir regularly. Water levels may be measured by simple elevation gauges either by staff gauges or by numbers painted on permanent fixed structures in the reservoir or they may use complex devices that sense water level (Automatic Water Level Recorders).
Barrage level data is to be recorded after the 15 minutes interval regularly and recorded on Barrage Shift register.