KUTHER HEP
(240 MW)
District Chamba (H.P.)

Emergency Action Plan(EAP)

Project Identification Code of Dam HP173MH0029

Prepared By:
JSW ENERGY (KUTEHR) LIMITED

JSW Energy

KUTHER BARRAGE

Project ID Code [HP173MH0029]

District Chamba

The First Edition of Emergency Action Plan for Kutehr HEP is prepared during July 2025, prepared in line with the "CWC Guidelines, 2016 for Developing Emergency Action Plans for Dams".

Disclaimer

Every effort has been taken to estimate the severity of flooding and inundation areas likely to be affected by KUTEHR BARRAGE in an emergency condition. These estimates are based on available primary and secondary data. Every effort has been made to foresee varied emergency possibilities and develop appropriate notification procedures for timely rescue and relief operations. However, implementation of the Emergency Action Plan (EAP) involves many agencies, who are required to work in a coordinated manner to reduce the consequences of the emergency trigger by the dam site condition. Effectiveness of the rescue and relief operations depend on many factors including the adequacy and accuracy of the estimation of the severity of flooding, coordinated efforts of all the agencies involved in rescue and relief efforts and availability of facilities like power, telephones, road communications, etc. EAP Developer may therefore, not be held responsible for the efficacy of the EAP.

For any information, please contact:
Ajay Nath
Head of Plant (HOP)
JSW Energy (Kutehr) Limited
VPO Garola, Tehsil – Holi, District – Chamba
Himachal Pradesh, Pin Code 176309

KUTEHR BARRAGE

Contents

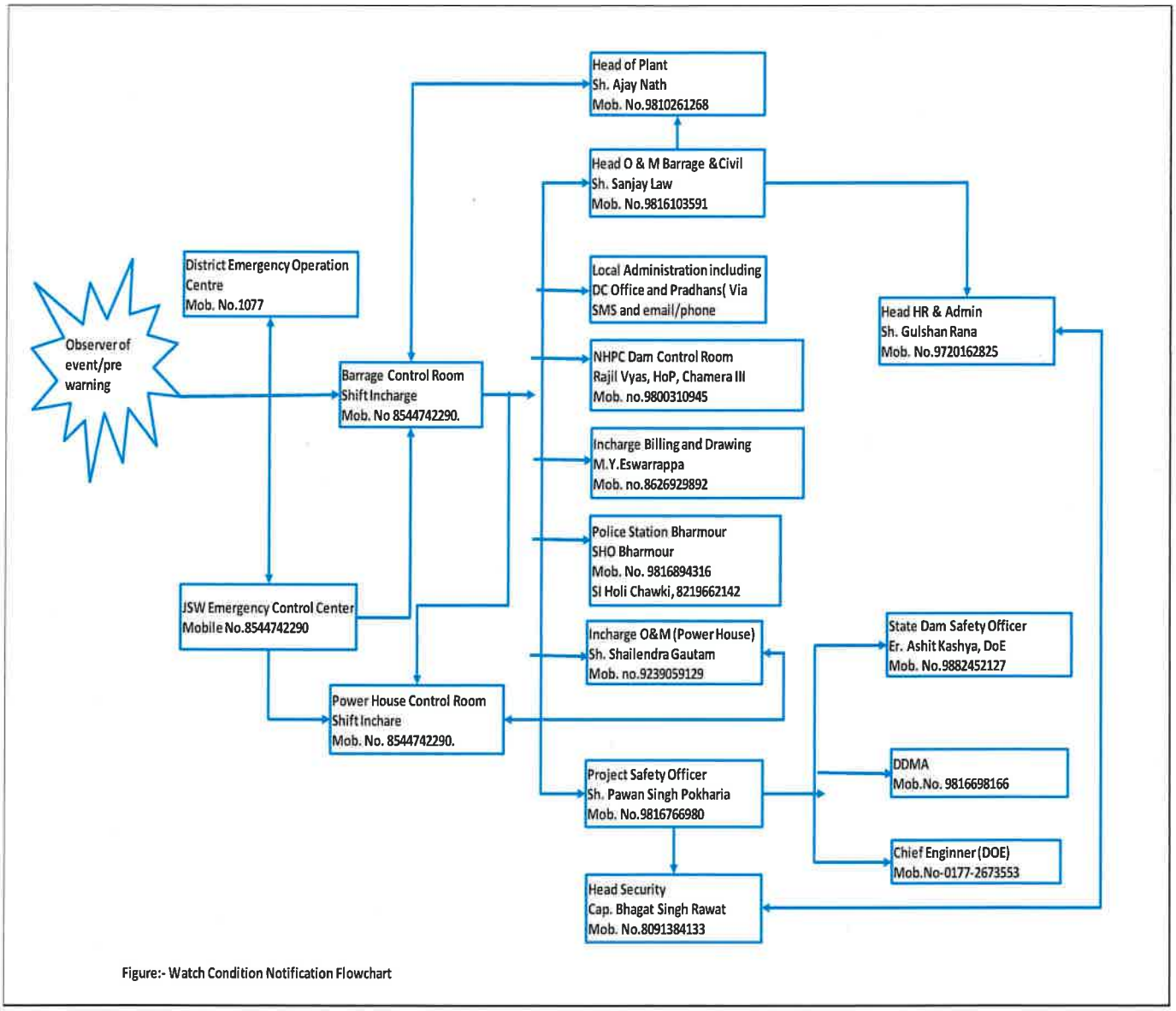


Figure:- Watch Condition Notification Flowchart

Sample internal alert (watch condition) notification flowchart.

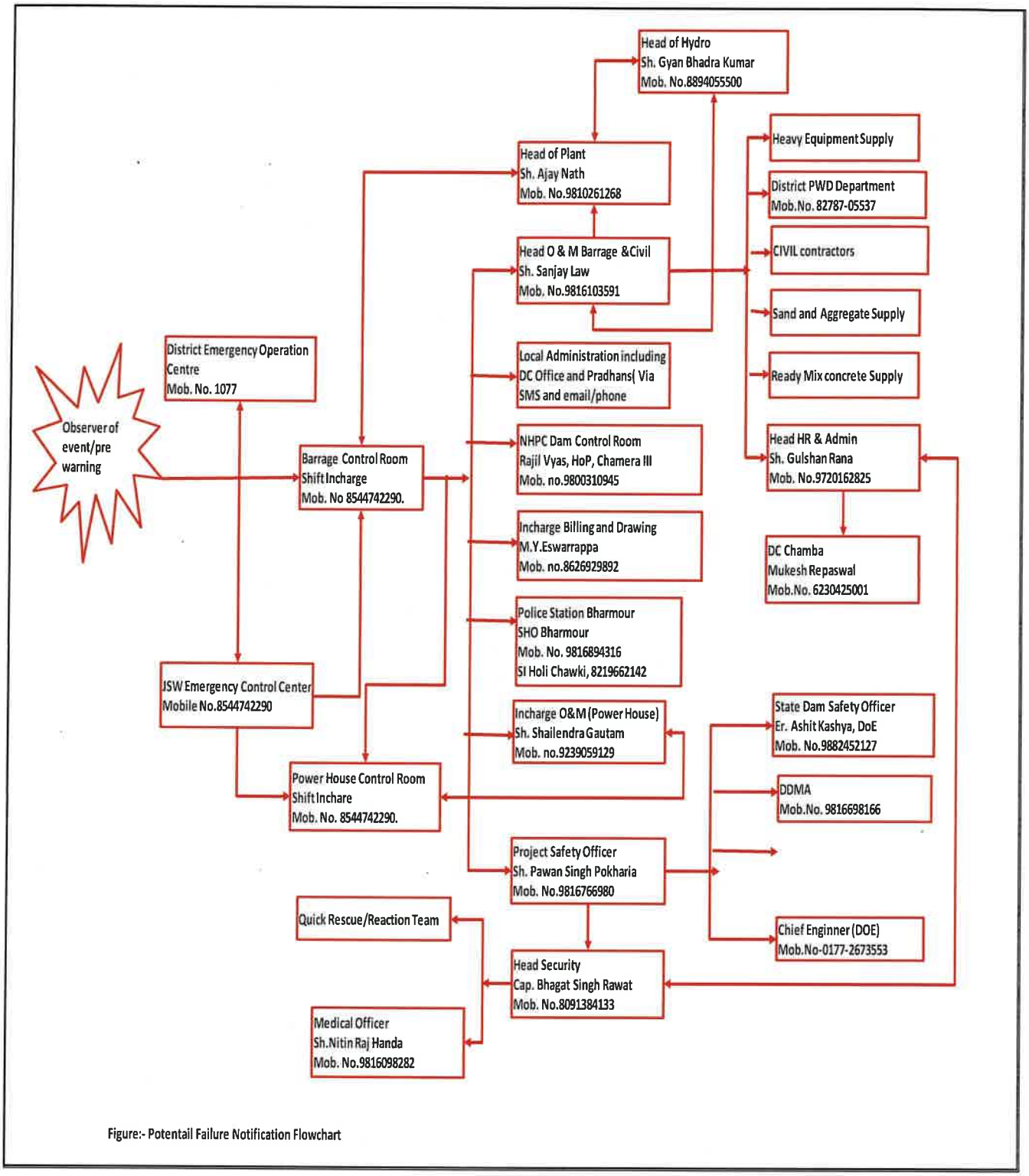


Figure:- Potentail Failure Notification Flowchart

Sample external alert (Potential failure condition) notification flowchart.

Kutehr HEP (240 MW)

Project ID Code - HP173MH0029

EAP Distribution List

A copy of the EAP has been provided to the following people:

Sr. no	Authority	Name, Title, Phone	Address
1	Head of Plant	Ajay Nath (Head of Project) 9810261268	VPO – Garola, Tehsil – Holi, District – Chamba (H.P.)
2	Head Civil	Sanjay Law (GM), 9816103591	-do-
3	In-charge Kutehr Barrage	Sanjay Law (GM), 9816103591	-do-
4	In-charge Power House	Shailendra Gautam (O&M head), 9239059129	-do-
5	Head Safety	Pawan Singh Pokharia (AGM), 9816766980	-do-
6	NHPC Chamera III Dam	Rajil Vyas, HoP, Chamera III, 9800310945	Chamera II HEP
7	DC, Chamba	Sh. Mukesh Repaswal, DC, Chamba 6230425001	DC office Chamba.
8	Police station, Bharmour	Babu Ram, SHO Bharmour 9816894316	Bharmour, Chamba
9	Chief Engineer (Authority), Directorate of Energy (DOE), GoHP	0177-2673553	Shimla, Himachal Pradesh
10	State Dam Safety Organization	Er. Ashit Kashyap Phone +91 9882452127	Shimla, Himachal Pradesh
11	District Disaster Management Authority [Chamba District]	Phone +91 9816698166	Chamba, Himachal Pradesh
12	District Public Works Department [Chamba District]	Er. Dinesh Kumar Phone +91 82787-05537	Chamba, Himachal Pradesh

Kutehr HEP (240 MW)

Project ID Code HP173MH0029

Log Sheet of Changes

The following changes have been made to the EAP and revisions have been provided to the people shown on the EAP Distribution List.

Date	Change Made	Signature
17th July 2025	Prepared as per CWC guidelines	

Kutehr HEP (240 MW)

Project ID Code - HP173MH0029

Approval and Implementation

This Emergency Action Plan is hereby approved. This plan is effective immediately and supersedes all previous editions.

Ajay Nath
AVP & Head of Plant (HOP)
JSW Energy (Kutehr) Limited

Date : 18th July 2025

I have received a copy of this Emergency Action Plan and concur with the notification procedures.

[Signature(s)]

[Name and Title of Person(s) in charge of Emergency Response] Date

Kutehr HEP (240 MW)
Project ID Code - HP173MH0029

1. Purpose

The purpose of this Emergency Action Plan (EAP) is to identify emergency situations that could threaten **KUTEHR BARRAGE** and to plan for an expedited, effective response to prevent failure of the Barrage and warn downstream residents of impending danger. This plan defines the notification procedures to be followed in the event of a potentially hazardous situation. The procedures are intended to protect lives and prevent property damage from an excessive release of water from the barrage spillways or an uncontrolled outflow of water from the breached portion of Barrage.

2. Barrage Description

2.1. General

Kutehr HEP Barrage and Reservoir are owned and operated by M/s. JSW Energy (Kutehr) Limited. It is located in the upper reaches of Ravi basin in District Chamba, approximately 75 kilometers from Chamba City, Himachal Pradesh on River Ravi. Main Tributary are Kurhed Nala & Holi Nala in the upstream of Barrage site. The Barrage construction is completed and reservoir filled, Project No. **HP173MH0029** granted to Owner in 2007. The project is under R-O-R scheme to produce electricity.

A vicinity map showing the location of the barrage is presented in Table 1. Inundation maps showing the areas subject to flooding as a result of a Barrage failure attached as Table-2. Lastly, a description of the barrage, its spillways, and other features are outlined in the Barrage Description in Tab 3.

2.2. Reservoir Operations

"Releases from the reservoir are controlled" by the radial gates and further in addition to the radial gates stoplog spillway is also available in the barrage. The operation of the reservoir is regulated by the approved operation manuals of the Kutehr Barrage, showing the sequence of the gates as per the inflow experienced in the Ravi River.

3. Responsibilities

3.1. Dam Owner's Responsibilities

The barrage owner, M/s. JSW Energy (Kutehr) Limited is responsible for all barrage operation and maintenance. The EAP will not designate a specific person for a specific responsibility but instead will designate the person's duties or job description.

In-charge Kutehr Barrage is the first line of dam observers and is the person responsible for initiating implementation of the EAP.

The In-charge Kutehr Barrage is responsible for collecting weather forecasts and the inflow forecasts and alerting of any potential emergency situation.

The In-charge Kutehr Barrage is responsible for conducting routine barrage maintenance, such as annual weed control, conducting dam integrity inspections, and notifying Head of Plant & Head of Hydro of any potential emergency situations.

The In-charge Kutehr Barrage is responsible for contacting emergency personnel.

The Head Environment is responsible for updating the EAP. An annual EAP review will be conducted to ensure that contact names and numbers are current on the Notification Flowcharts.

The In-charge Kutehr Barrage is responsible for directing specific, incident appropriate actions during an emergency, such as opening or closing water outlets and remedial construction activities such as earth moving, etc. Specific scenarios are not listed in this EAP.

3.2. Responsibilities for Notification

The In-charge Kutehr Barrage is responsible for inspecting the dam in a potential emergency such as the potential threat of high waters or a tropical cyclone. The Head Safety will contact Local Police, affected Gram Panchayats, Chamba District Police, Bharmour Police, District Magistrate/Collector and all the stakeholders to whom the EAP is distributed as per the list and flowcharts attached depending upon the situation of the incident.

If warranted, the Head Safety will notify the State and District Disaster Management Authorities. The district authorities, Bharmour Police will notify downstream residents. The In-charge Kutehr Barrage will implement the Notification Flowchart for regional and state disaster management contacts.

3.3. Emergency Operations Center

In the event of a **failure condition**, Head of Plant (HOP) will activate the Emergency Operations Center to serve as the main distribution center for warning and evacuation activities. The Emergency Operations Center will be established at the Main office of the project. Head of Plant will be responsible for initiating actions from this location.

3.4. Responsibilities for Evacuation

The local authorities and Bharmour Police and DDMA will be responsible for initiating evacuations.

3.5. Responsibilities for Duration, Security, Termination, and Follow-up

The In-charge Kutehr Barrage is responsible for monitoring of emergency situations at the barrage and keeping authorities informed, based on the Notification Flowcharts.

The In-charge Kutehr Barrage and the Chamba District Magistrate/Collector are responsible for declaring that an emergency at the dam is terminated. Applicable authorities will be notified based on the Notification Flowcharts.

The Head of Plant will ensure that a follow-up evaluation is completed by all participants after the emergency. The results of the evaluation should be documented in a written report and filed with the EAP.

3.6. Communications

Local officials and downstream residents will be notified by JSWEKL through landline telephone, cell phones or emergency personnel through public addressing system. The various networks for emergency use include the networks of the following:

- The Chamba District Police, Bharmour & Holi Police.
- The District Magistrate
- The Himachal Pradesh State Disaster Management Authority
- The Himachal Pradesh, Ministry of Road Transport and Highways.
- Superintending Engineer (PWD) & (I&PH).
- Chairperson of Zila- Parishad.
- In-charge Power House.
- In-charge NHPC Chamera III HEP.

Sample public announcements appear in Tab 4. Verification or authentication of the situation can be made by contacting the In-charge Kutehr Barrage and Chamba District Authorities, DDMA, SDMA management officials. Television, Radio and bulk SMS facilities of the local Mobile Network Operators can be used as much as possible to notify area residents of the possible dangers.

Public announcements are to be issued by JSW Energy (Kutehr) Limited public affairs officer and In-charge Kutehr Barrage by initiating alarms installed at various locations in the downstream of the Kutehr Barrage.

In addition to above patrolling team will blow sirens throughout the project areas.

Sirens are installed at: -

1. Barrage Complex.
2. Near Dalli Bridge.
3. Near Choli Bridge.
4. Near Machetar Bridge/ Sub Station.
5. Near Siyur Bridge.
6. Near Garola Village and Power House Complex.

4. Emergency Detection, Evaluation, and Classification

4.1. Emergency Detection

A. Situations

Many dam conditions can lead to emergency situations, not all of which will necessitate the implementation of the EAP. However, if any of them occur, the appropriate actions must be taken.

- Severe Storms/Inclement Weather: Although generally not in themselves a threat to the dam, severe storms and other inclement weather conditions can contribute to an existing problem and hinder any remediation efforts. Severe storms also cause the uncontrolled release of floodwater, and increase flow in already rain-swollen areas.
- Tropical cyclones: Tropical cyclones do occur in the area, with the potential for structural damage to the dam, possibly resulting in its failure. If a tropical cyclone has struck in the area, an inspection of the dam for any signs of damage will be ap- propriate.
- Earthquakes: Kutehr HEP is located in the seismic zone V. An earthquake is a possibility, and appropriate post-earthquake inspections should be performed.
- Sabotage: A threat to damage the barrage has been made. Appropriate actions must be taken to protect the barrage.

B. Signs of Failure

The In-charge Kutehr Barrage is responsible for conducting routine inspections and identifying conditions that could indicate the onset of problems leading to a barrage failure. The early identification of potentially dangerous conditions can allow time for the implementation of EAPs. It is important to understand how distress can develop into failure. With appropriate action, distress need not lead to a catastrophic failure of the barrage. The following sections describe some of the different types of failure which could lead to a dam failure.

- Seepage Failure: Although all earthen embankments allow some minor seepage through the dam or the foundation, excessive, uncontrolled seepage can result in piping (the movement of embankment material in the seepage flow) and lead to failure. Piping can occur for years at a slow rate. If the piping has progressed to a dangerous level, it will be evident by increased flow or the discharge of muddy water (or both). At that stage, immediate action to stop the piping is needed. Fully developed piping is difficult to control and is very likely to result in failure. A whirlpool in the reservoir is a sign of uncontrollable piping and necessitates immediate emergency action.
- Embankment or Foundation Sliding: Sliding is usually first apparent when cracks or bulges in the embankment appear. Slides with progressive movement can cause failure of the embankment.
- Structural Failure: The structural failure or collapse of any non-overflow portion of the dam, spillway or spillway gates could result in loss of the reservoir. A structural failure of a portion of the spillway could cause piping and possibly embankment failure.

- Overtopping Failure: Overtopping of the embankment results in erosion of the dam crest. Once erosion begins, it is very difficult to stop.

4.2. Emergency Evaluation and Classification

This section lists the conditions and actions which may be used to classify the level of emergency response, as a guide for the In-charge Kutehr Barrage. Specific dam observations and corresponding emergency classification levels can be found in the Evidence of Distress table in Tab 5.

Internal Alert Condition BLUE – A "watch" condition. A problem has been detected at the dam that requires constant monitoring. At this time, the distress condition is manageable by dam personnel. The In-charge Kutehr Barrage will be responsible for monitoring and repair as soon as possible and implementing the appropriate Notification Flowchart. The following is a list of conditions that would initiate this condition:

- Cloudy or dirty seepage or seepage with an increase in flow, boils, piping, or bogs
- Seepage around conduits
- Large sinkholes with corresponding seepage anywhere on the embankment or down- stream from the toe
- Any slide that degrades the crest of the embankment or that is progressively increasing in size
- Cracking or movement of any concrete structure
- An increase in the reservoir level leading to engagement of the emergency spillway
- Exceptionally heavy rainfall in the catchment of the dam reservoir

External Alert Condition ORANGE – This is indicative of a dam condition that is progressively getting worse; and there is a high probability of dam failure. Although there is no immediate danger, the dam could fail if conditions continue to deteriorate. The In-charge Kutehr Barrage will be responsible for initiating immediate repairs, including lowering the reservoir if appropriate and implementing the appropriate Notification Flowchart. The following is a list of conditions that would initiate this condition:

- Large boils, increasing in size and flow rate, especially if there is flowing muddy water
- Significantly increasing seepage, especially flowing muddy water
- Slides involving a large mass of material that impairs the crest of the dam and is continuing to move
- Sinkholes with seepage flowing muddy water
- Large cracks, movement or failure of a portion of any major concrete structure that forms an integral part of the dam
- An increase in the reservoir level to near the top of the dam
- Overtopping of a dam that is not designed for overtopping
- Near to 'Design Flood' inflow forecast

External Alert Conditions RED – These are "failure" conditions. Either the dam is in immediate danger of failing or has already failed. No time remains to implement measures to prevent failure. Evacuate immediately. Evacuation efforts will continue until the situation is stabilized.

The In-charge Kutehr Barrage is responsible for implementing the appropriate Notification Flowchart. The following is a list of conditions that would initiate "imminent dam failure" or "dam failure" conditions:

- Rapidly increasing boils or the presence of new, significantly flowing boils, particularly muddy ones near previously identified ones
- Rapidly increasing seepage, especially flowing muddy water
- Slides involving a large mass of material or which have degraded the crest of the embankment to a level that approaches the water surface level, or if significant seepage is observed through the slide area
- Settlement that is predicted to degrade to the reservoir level
- Cracks that extend to the reservoir level
- Significant movement or failure of any structure that forms an integral part of the dam
- Overtopping of an earthen dam
- Uncontrollable release of the reservoir

4.3. Previously Known Problems

During the construction phase of the project Kutehr Barrage experienced heavy flood in the year 2021, 2022 & 2023. Also prior to the construction of the project a major flood was experienced in the Ravi River in the year 2018-19.

5. Preparedness

Preparedness actions are to be taken both before and following the development of emergency conditions and should identify ways of preparing for an emergency, increasing response readiness in a uniform and coordinated manner, and helping to reduce the effects of a dam failure. The following are some steps that could prevent or delay failure after an emergency is first discovered.

Surveillance: The In-charge Kutehr Barrage will monitor the dam during emergency situations such as a severe storm event.

Response on forecast of excessive inflow: The In-charge Kutehr Barrage will respond to situation of excessive inflow forecast by way of controlled spillway releases after ascertaining the reliability of the forecast.

Response during weekends and holidays: The In-charge Kutehr Barrage will be available for emergency response during weekends and holidays and can be present at the dam site within 15 minutes of detection of an emergency condition.

Response during periods of darkness and adverse weather: The In-charge Kutehr Barrage will arrange for access to generators and lights to adequately monitor the situation. The In-charge Kutehr Barrage will be able to access the site during adverse weather conditions by foot, utility vehicle, or some other means.

Access to the site: Alternate access routes is planned in the event of an emergency at the dam. The State Highway Road to Holi is in the Left bank of the reservoir and it is accessible in all weather conditions by foot in case of heavy rainfall and snow.

Preventive measures can be taken in an emergency to prevent the catastrophic failure of the dam, but such repairs should be undertaken with extreme caution. The repairs are only temporary, and a permanent repair should be designed by an engineer as soon as possible.

The following actions should only be undertaken under the direction of a professional engineer or contractor. In all cases, the appropriate Notification Flowchart must be implemented and the personnel of the SDSO at DOE (Shimla) must be notified.

Consider the following preparedness actions if the dam's integrity is threatened by:

Seepage Failure

- Plug the flow with whatever material is available (hay, bentonite, or plastic) if the entrance is in the reservoir.
- Lower the water level in the reservoir by using the low flow outlet and pumping, if necessary, until the flow decreases to a non-erosive velocity or until it stops. Place an inverted filter (a protective layer of sand and gravel) on the exit area to hold the material in place.
- Continue operating at a lower level until a repair is made.

Embankment or Foundation Sliding

- Lower the water level in the reservoir by using the low flow outlet and pumping, if necessary, at a rate and to an elevation considered safe, given the slide condition.
- Stabilize the slide, if on the downstream slope, by weighting the toe area below the slide with soil, rock, or gravel.
- Continue operating at a lower level until a repair is made.

Structural Failure

- Implement temporary measures to protect the damaged structure, such as placing rock riprap in the damaged area.
- Lower the water level to a safe elevation through the low flow outlet and by pumping if necessary.

6. Supplies and Resources

6.1. Contracts

If JSWEKL personnel and resources prove to be inadequate during an emergency, requests will be made for assistance from other local jurisdictions, other agencies, and industry, as needed. Such assistance may include equipment, supplies, or personnel. All agreements will be entered into by authorized officials and should be in writing whenever possible. Head of Plant (HOP) and In-charge Kutehr Barrage shall have the authority to enter into agreements as deemed necessary to prevent the failure of the dam.

6.2. Equipment and Supplies

Equipment that is available for use and local contractors that can be contacted to provide equipment during an emergency event are listed in Tab 6.

6.3. Reports

Technical

Data

Pre-monsoon and post-monsoon inspections of the dam will be made to evaluate its structural safety, stability, and operational adequacy. In the event of an abnormal occurrence, reference to these reports, particularly the photographs, can be beneficial in the evaluation of a potential problem.

Technical records such as drawings and inspection reports should be stored and carefully maintained at the Kutehr Barrage Site office as well as main office of the project. Alternate personnel will be familiar with the location of the documents in the event of an emergency situation.

Emergency Operations Center Activity Log

Any unusual or emergency condition should be documented, including the following:

- Activation or deactivation of emergency facilities
- Emergency notifications to other local governments and to state and central government agencies
- Significant changes in the emergency
- Major commitments of resources or requests for additional resources from external sources
- Telephone calls should be recorded in chronological order
- Issuance of protective action recommendations to the public
- Evacuations
- Casualties
- Termination of the incident

Costs of the Emergency Operations Center

For major emergencies, the emergency operations center will maintain detailed records of costs expended. These records may be used to recover costs from the responsible party or insurers, or as a basis for requesting financial assistance for certain allowable response and recovery costs from the state or central government. Documented costs should include:

- Personnel costs, especially overtime
- Equipment operation
- Equipment leasing and rental
- Contract services to support emergency operations
- Specialized supplies expended in emergency operations
- Material cost.

7. Inundation Area

The inundation map illustrates the areas subject to flooding from a failure of the dam. The map is prepared by National Institute of Hydrology (NIH) Roorkee using the results of Dam break analysis. The same is provided in **Table-2**.

7.1. Local Evacuation Plan

If imminent failure of the dam with uncontrolled downstream flooding is anticipated, local disaster management and law enforcement personnel should notify those downstream, for evacuation in the most expedient manner possible. The organizations and personnel on the Notification Flowchart should be contacted immediately. Local law enforcement officials, along with local mobile network operators, radio and television stations can best spread the notice for evacuation. The immediate impact will be to areas along Ravi River downstream of the dam. For sunny-day and design flood breaches, the following actions should be taken:

- Barricading all bridges that could possibly be flooded to prevent access to the affected area. These bridges include the Ravi River crossings of Kharamukh to Holi Road.
- The District Disaster Management office can assist with the notification of all persons and agencies involved, with the possibility of additional support including contacting others not accessible by radio or telephone.
- District officials are generally familiar with developed areas in their jurisdiction. Such knowledge, coupled with the requirements of state law that they respond to disasters, make them the logical officials to be notified and to spread the warning message to all areas subject to flooding.

8. Implementation

8.1. Development

The First draft of EAP is being sent to SDSO (DOE) Shimla Go. H.P for kind information, review and records.

The review and comments by SDSO will be incorporated into this document.

8.2. Updating

Copies of the EAP have been provided to the appropriate persons and the EAP has been approved and signed by the owner and the person(s) in charge of emergency response, as shown on the Distribution List and Approval and Implementation sheets at the front of the report. This plan will be reviewed and updated annually by JSWEKL in conjunction with In-charge Kutehr Barrage after annual maintenance inspection of the Kutehr Barrage. The In-charge Kutehr Barrage will review and complete all items on the Annual EAP Evaluation Checklist in Tab 7. After the annual update is complete, a new Approval and Implementation sheet will be attached and the annual update will be documented on the Plan Review and Update sheet in Tab 8.

If revisions to the EAP are made as a result of the annual update, such changes will be recorded on the Log Sheet of Changes form at the front of the report. A copy of the updated portions of the EAP will be sent to the SDSO and all other concerned as per the EAP Distribution List. If the EAP was reviewed and revisions were not required, the JSW Energy (Kutehr) Limited will submit written notification to all concerned that no updates to the EAP have been adopted or implemented.

8.3. Testing

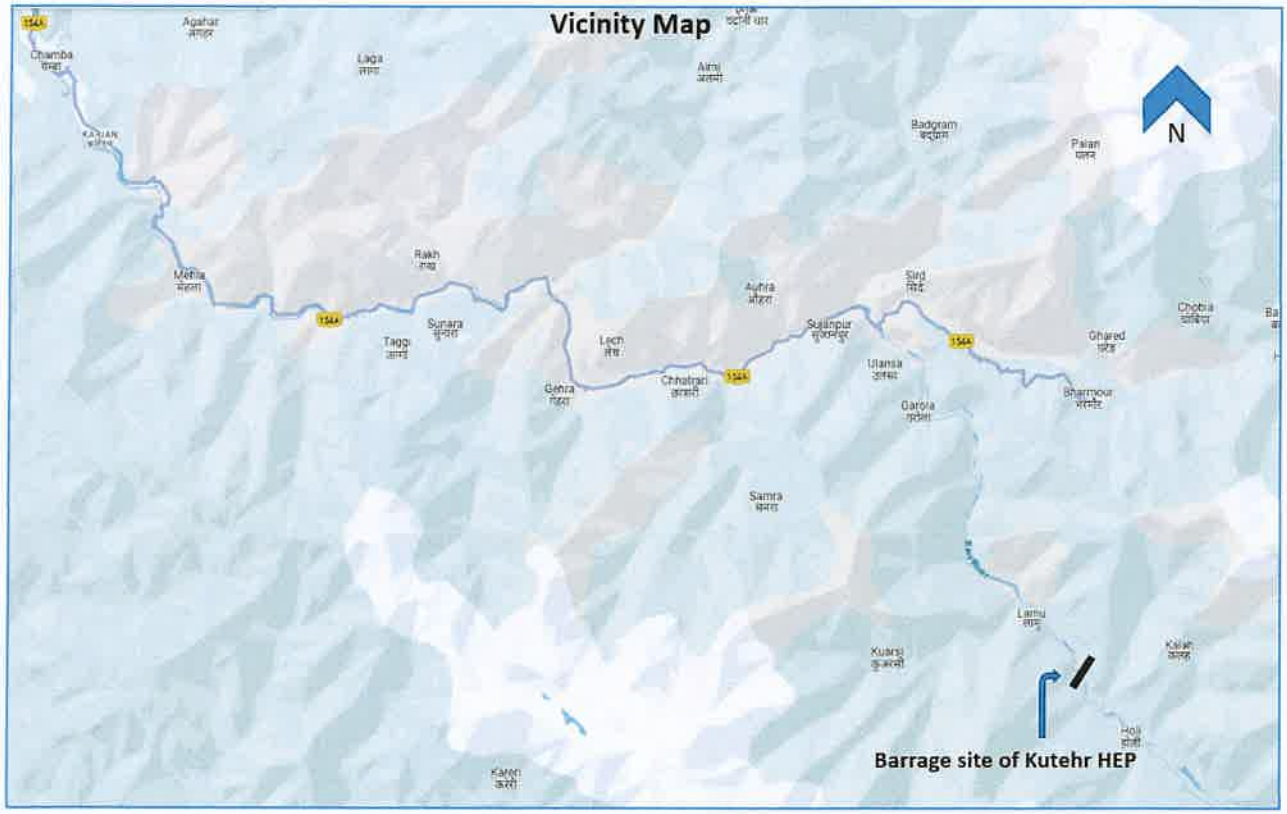
A table top drill will be conducted at least once every five years. The table top drill involves a meeting of In-charge Kutehr Barrage, Head Safety and JSWEKL officials involved in the preparation, implementation and other related works of Emergency action Plan with local and state disaster management officials in a conference room. The drill begins with a description of simulated event and proceeds with discussions by the participants to evaluate the EAP and response procedures, and to resolve concerns regarding coordination and responsibilities. Any problems identified during a drill should be included in revisions to the EAP. Records of training and drills will be maintained in Tab 9.

8.4. Training

All people involved in the EAP will be trained to ensure that they are thoroughly familiar with its elements, the availability of equipment, and their responsibilities and duties under the plan. Personnel will be trained in problem detection, evaluation, and appropriate corrective measures. This training is essential for proper evaluation of developing situations at all levels of responsibility. Training records will be maintained in Tab 9.

Tab 1

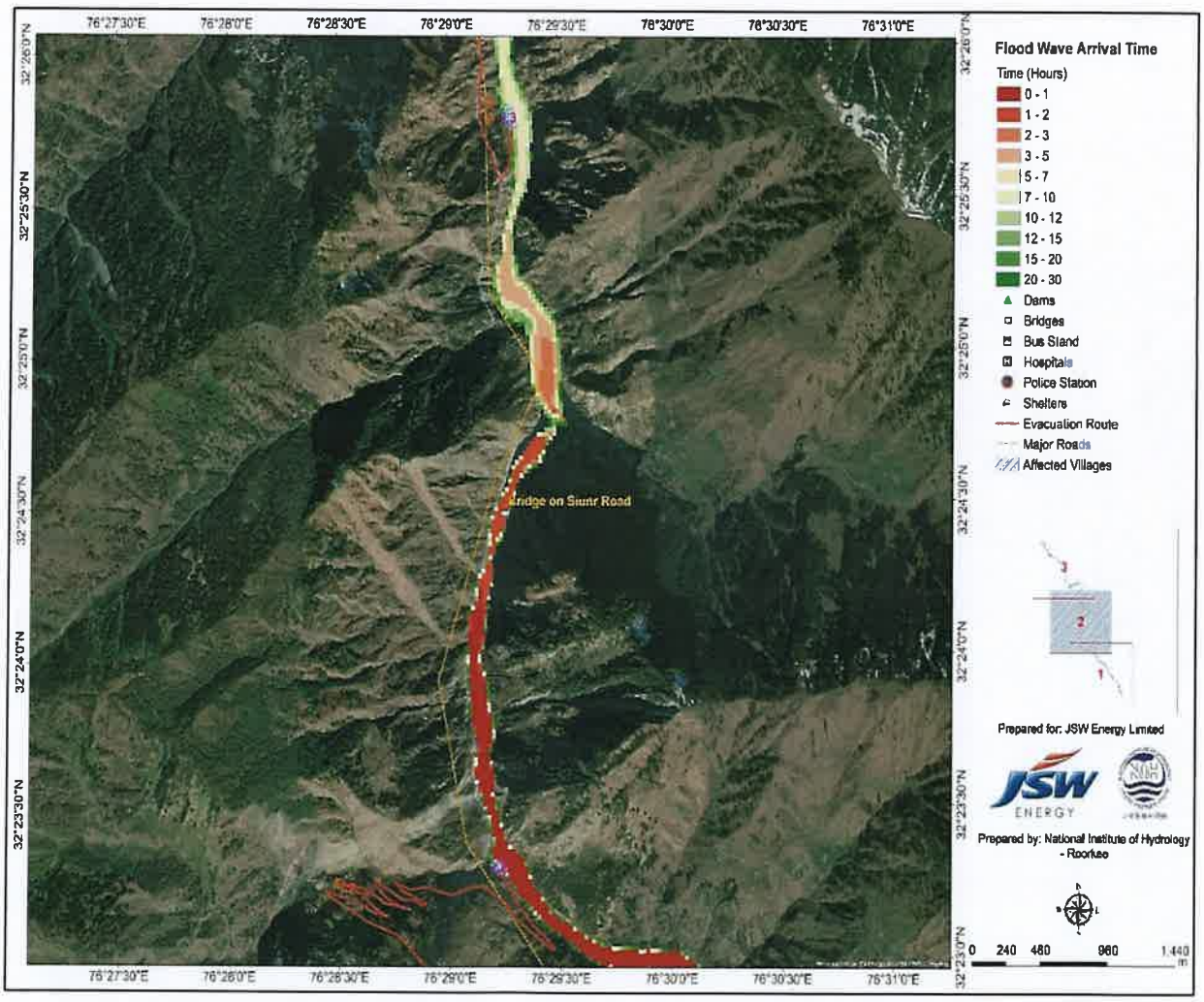
Vicinity Map

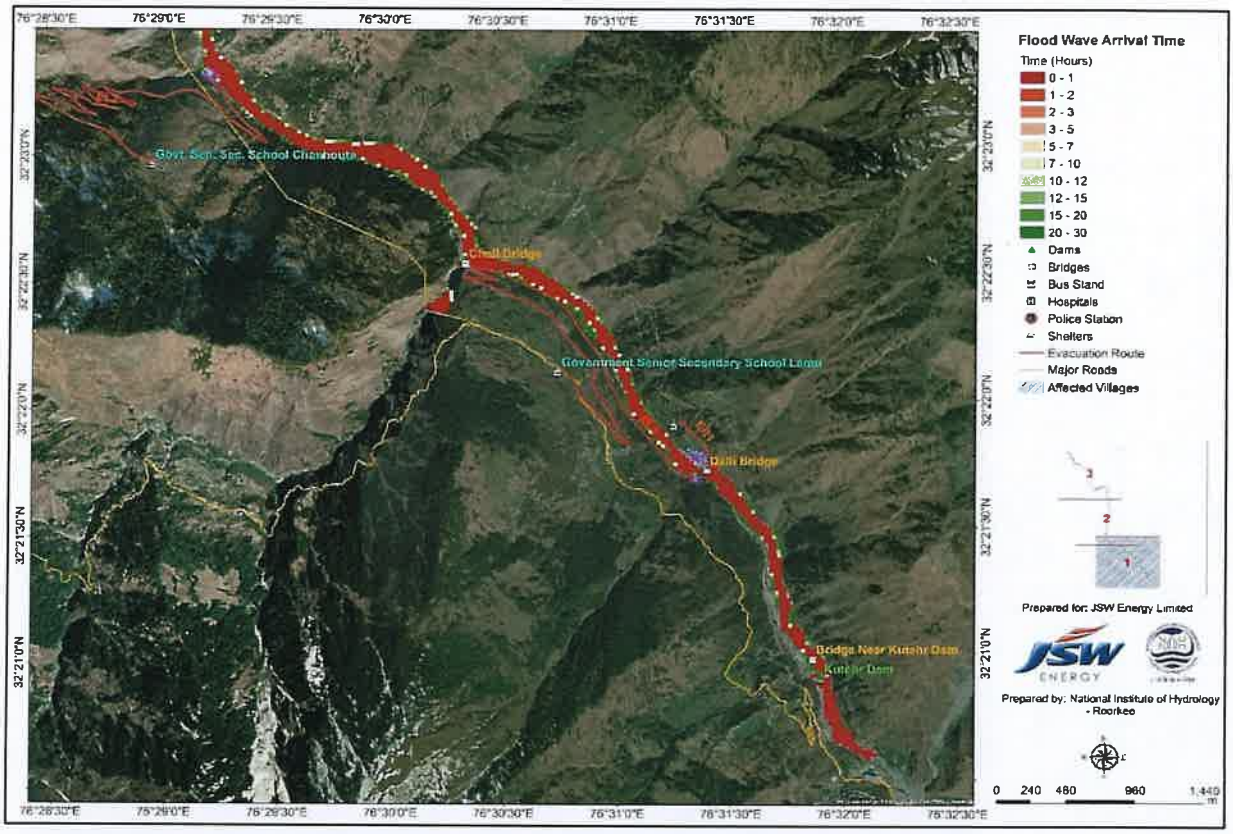


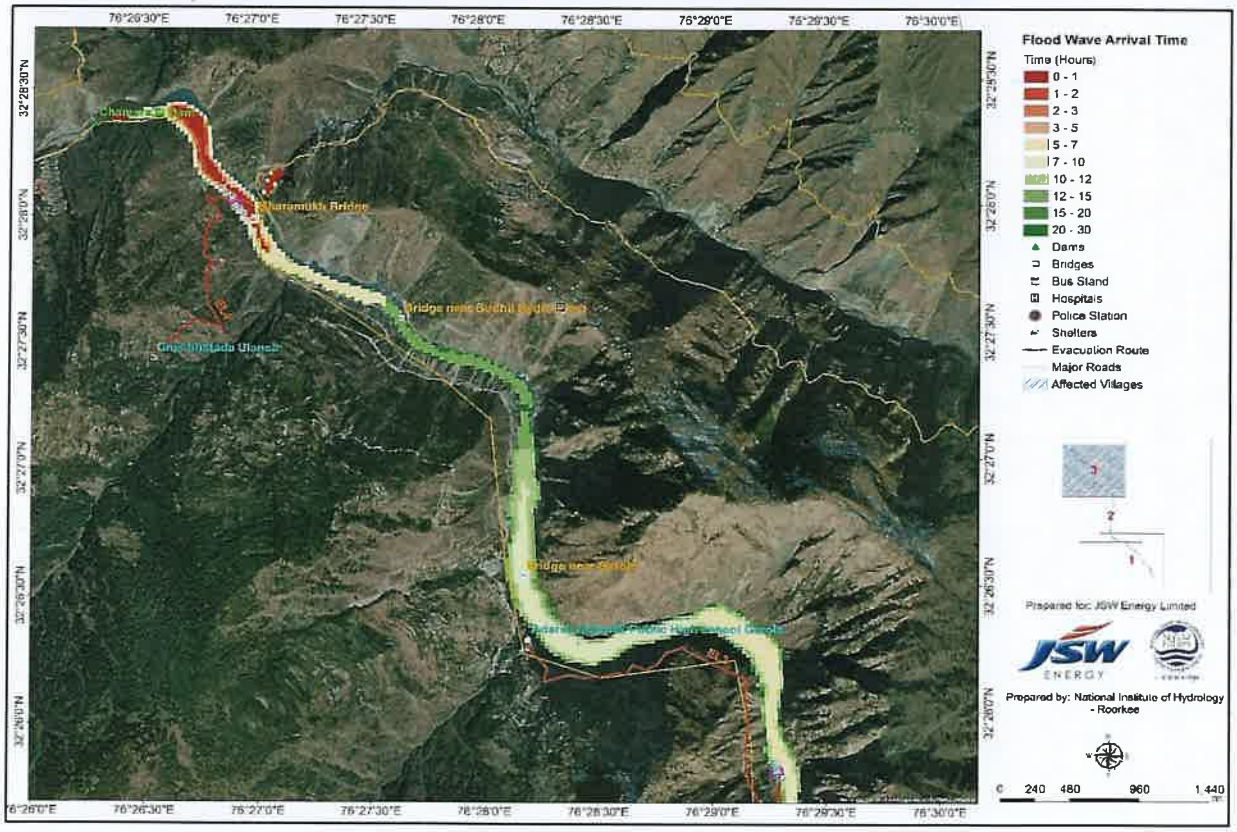
Tab 2

Inundation Map

An inundation map is prepared along with the Barrage Break Analysis study being conducted through an independent agency National Institute of Hydrology. The detailed maps are as follows.




Flood Wave Arrival Time
Time (Hours)
0 - 1
1 - 2
2 - 3
3 - 5
5 - 7
7 - 10
10 - 12
12 - 15
15 - 20
20 - 30
Dams
Bridges
Bus Stand
Hospitals
Police Station
Shelters
Evacuation Route
Major Roads
Affected Villages
Prepared for: JSW Energy Limited
Prepared by: National Institute of Hydrology - Roorkee
0 240 480 960 1,440 m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Shelters
Evacuation Route
Major Roads
Affected Villages
Prepared for: JSW Energy Limited
Prepared by: National Institute of Hydrology - Roorkee
0 240 480 960 1,440 m

Tab 3

Dam Description

Official Barrage Name:	**Kutehr Barrage**
Name of Stream:	**Ravi River**
Dam Location:	**Near Village Kutehr**
Latitude/Longitude:	Latitude: 32.34940833 Longitude 76.53150833
Seismic Zone:	V

Year of Starting of Dam Construction: **October, 2019**

Year of First Impoundment: **2025**

Year of Commissioning of Dam Project: Expected in Q2 FY-26.

Name of Immediate Upstream Dam: GMR Bajoli Holi.

Name of Immediate Downstream Dam: NHPC Chamera III

Phone Number: JSW Emergency Control Center, 8544742290

Dam Owner's Address: Village Chanhouta, PO Machhettar, Tehsil Holi, District Chamba (H.P) 176309.

Kutehr Hydro Electric Project (3x80=240 MW)– H.P. by M/s JSW Energy Limited
- Salient features

1.	**Location**	
	State	Himachal Pradesh
	District	Chamba
	River	Ravi
	River Basin	Indus
	Barrage Site- Latitude	32° 20'52" N
	Longitude	76° 31'58" E
	Vicinity	Near Holi Village
	Powerhouse Site- Latitude	32° 27'36" N
	Longitude	76° 27'36" E
2.	**Hydrology**	
	Catchment area	1155 km^2
	Area under snow	305 km^2
	Elevation of Snow Line	El:4600 m
	Probable max. flood for 50-year	5796 cumec
	Probable max. flood for 100-year	6681 cumec
	Standard project flood (SPF)	8328 cumec
	Diversion flood	302 cumec
3.	**Reservoir**	
	FRL	1706.75 m
	MDDL	1700 m
	Live Storage	0.65 MCM
	Submergence Area	11.3141 Ha
4	**Barrage- Spillway**	
	Barrage ht. from foundation level	27 m
	Barrage length	193.5 m
	Barrage width at top (Bridge)	6 m
	Top of Barrage	1708 m
	Barrage crest Elevation	1685 m
	Number of bays of spillway	5 Nos.
	Gate type and size	Radial, 11 m(W)x12.5 m(H)
	Stop log type and size	Vertical lift slide type, 11 m(W)x14.9 m(H) (1 Set)
5.	**Intake (on Left Abutment)**	
	Number of Trash racks & size	4 Nos., 3.5 m x10 m
	Gate type	Vertical lift fixed wheel type (Service gate) Vertical lift slide type (Maintenance gate)
	Number of gates and size	4 Nos., 3.5 m(W)x 4.75 m(H)
6.	**Feeder Tunnels**	
	Shape	Modified D- shape
	Nos. and size	2 Nos., each of 3.5 m(W)x 5 m(H)
	Length	644 m / 585 m

7.	**Desanding Chambers**	
	Type	Underground
	No. and size	2 Nos., 290 m(L)x15 m(B)x15.9 m (H)
	Flushing Tunnel Gate type	Vertical lift slide type
	Nos./size of Flushing Tunnel Gate	4 Nos., 1.55 m(W)x2 m(H)
	Size of Particle to be removed	> 0.2 mm
8.	**Head Race Tunnel**	
	Number and Shape	1 No., Circular
	Lining type	Concrete lined
	Length	14.602 km,
	Size	6.2 m Diameter
	Design Discharge	96.8 m^3/s
9.	**Surge Shaft**	
	Type	Open to sky Restricted orifice vertical shaft
	Diameter	15 m
	Total Height	87.45 m
	Surge shaft top	1737 m
10.	**Butterfly Valve**	
	Number and Diameter	1 No., 4.35 m Dia.

11. **Pressure shaft**	**Main Pressure Shaft**	**Intermediate Pressure Shaft**	**Unit Penstock**
Type	Steel lined subsurface penstock		
Number	1	1	3
Diameter	4.35 m	3.55 m	2.5 m
Maximum discharge	96.8 m^3/s	64.53 m^3/s	32.27 m^3/s
Length of penstock	317.425 m (vertical reach 253.325 m)	17.4 m	38.5 m/ 32.3 m/42.6 m

12	**Power House**	
	Type	Underground
	Number of Units	3
	Unit capacity	80 MW
	Installed Capacity	240 MW
	Design Head	280.47 m
	Rated discharge per Unit	32.27 Cumecs
	Type of Turbine	Vertical axis Francis
	Speed of Turbine	375 rpm
	Generation Voltage/ Frequency	11 kV/ 50 Hz
	Power factor	0.9
	Size of machine Hall	90 m (L) x 19 m (W) x 44 m (H)
	Capacity of EOT Crane	200T/ 32 T
13.	**Generator Transformers**	
	Numbers	10 Nos. (9 +1 No. Spare)
	Rating	11/220 kV, 30 MVA, Single phase
	Transformer Cavern	90 m (L) x 16 m (W) x 44 m (H)

14.	**Tail Water Level**	
	Minimum TWL at no flow	1397 m
	Normal TWL(All units at rated discharge)	1402.8 m
15.	**Tailrace Tunnel**	
	Shape and size	Circular, 6.2 m dia.
	Length	275 m

Tab 4

Sample Public Announcements

Note: These messages are communicated to downstream residents to alert the public of impending danger. The JSW Energy (Kutehr) Limited should coordinate with the India Meteorological Department, the Chamba Disaster Management Authority, and the District Magistrates/Collectors prior to release. Messages can be communicated via radio, television, bulk SMSs of local mobile networks, and other media outlets.

Announcement for a Slowly Developing "Watch" Condition (BLUE Emergency Level)

JSW Energy (Kutehr) Limited has declared a BLUE Level "Watch" condition for Kutehr HEP Barrage, **HP173MH0029** as of [time and date]. [Briefly describe the problem or condition.] Although there is no immediate danger of the dam failing, [Describe what actions are being taken to monitor and control the situation.] [State the quantity of any releases from the reservoir.]

Announcement for a Worsening "Watch" Condition (BLUE Emergency Level)

JSW Energy (Kutehr) Limited has declared a BLUE Level "Watch" condition for barrage of Kutehr HEP, Project Identification Code- **HP173MH0029** as of [time and date]. [Briefly describe the problem or condition.] Although there is no immediate danger of the dam failing a possibility now exists that the dam will fail if correction efforts are unsuccessful. Describe what actions are being taken to monitor and correct the situation.] [State the quantity of any releases from the reservoir]. Additional news will be made available as soon as it is received.

Announcement for a Probable "Failure" Condition (ORANGE Emergency Level)

Urgent! This is an emergency message. JSW Energy (Kutehr) Limited has announced that barrage of Kutehr HEP, Project Identification Code- **HP173MH0029** is probably going to fail. [Describe what actions are being taken to monitor and control the situation.] It is possible that the dam will fail in [##] hours. Residents in low lying areas along the [Stream], the [Stream], and the [Stream], as well as the town of [Name], should prepare for immediate evacuation. Additional news will be made available as soon as it is received.

Announcement of an Impending "Failure" Condition (RED Emergency Level)

Emergency! This is an emergency message. Barrage of the Kutehr HEP, Project Identification Code [Dam Name] is going to fail at any moment. Residents who have not yet done so should immediately evacuate the city of [Name] and low-lying areas along the [Stream], the [Stream], and the [Stream]. The flood waters have already reached [Highway] and [Road]. Additional news will be made available as soon as it is received.

Announcement of an Ongoing "Failure" Condition (RED Emergency Level)

Emergency! This is an emergency message. Barrage of Kutehr HEP, Project Identification Code - **HP173MH0029**. failed at [time and date]. Residents who have not yet done so should immediately evacuate the city of [Name] and low-lying areas along the [Stream], the [Stream], and the [Stream]. The flood waters have already reached [Highway] and [Road]. Additional news will be made available as soon as it is received.

Tab 5

Evidence of Distress

General observation	Specific observation	Emergency condition level	Emergency action	Equipment, material, and supplies	Data to record
Boils	Small boils, no increase of water flow, flowing clear water.	BLUE	Closely check all of downstream toe, especially in the vicinity of boil for additional boils, wet spots, sinkholes, or seepage. Closely monitor entire area for changes or flow rate increases.	None	Site and location, approximate flow
	Large or additional boils near previously identified ones, without increasing flow rate, but carrying small amount of soil particles.	BLUE	Initiate 24-hour surveillance. Monitor as described above. Construct sandbag ring dikes around boils, to cover them with water to retard the movement of soil particles. Filter cloth may be used to retard soil movement, but do not retard the flow of water.	Sandbags, filter cloth	Site and location, approximate flow
	Large or additional boils near previously identified ones, increasing flow rate, carrying soil particles.	ORANGE	Continue 24-hour surveillance. Continue monitoring and remedial action as described above. Initiate emergency lowering of the reservoir. Issue a warning to downstream residents.	Sandbags, pump	Site and location, approximate flow
	Rapidly increasing size of boils and flow increasing and muddy water.	RED	Downstream evacuation. Employ all available equipment to attempt to construct a large ring dike around the boil area.	Dozer, shovels, source of earth fill	Site and location, approximate flow
Seepage	Minor seepage of clear water at toe, on slope of embankment, or at the abutments.	BLUE	Closely check entire embankment for other seepage areas. Use wooden stakes or flagging to delineate seepage area. Try to channel and measure flow. Look for up- stream whirlpools.	Wooden stakes, flagging	
	Additional seepage areas observed flowing clear water and/or increasing flow rate.	BLUE	Initiate 24-hour surveillance. Monitor as described above. Construct measuring weir and channel all seepage through weir. Attempt to determine source of seepage.	Dozer, shovels	Site, location, approximate flow

General observation	Specific observation	Emergency condition level	Emergency action	Equipment, material, and supplies	Data to record
	Seriously or rapidly increasing seepage, under-seepage, or drain flow.	ORANGE	Continue 24-hour monitoring and remedial action as described above. Initiate emergency lowering of the reservoir. Construct a large ring dike around the seepage area.	Dozer, shovels, source of fill mate-rial	Site location , approx-imate flow
	Additional seepage areas with rapid in- crease in flow and muddy water.	RED	Downstream evacuation. Employ all available equip- ment to attempt to construct a large ring dike around the seepage area.	Dozer, shovels, source of fill mate-rial	Site lo-cation, approx-imate flow
Slides or severe erosion	Skin slide or slough on slope of embankment. No further movement of slide and embankment crest not de-graded.	BLUE	Examine rest of embank- ment for other slides. Place stakes in slide material and adjacent to it for determining if further movement is taking place.	Stakes, tape measure	Distance between stakes
	Slide or erosion in-volving large mass of material, crest of embankment is de-graded, no movement or very slow continuing movement.	BLUE	Initiate 24-hour surveillance. Mobilize all available re- sources and equipment for repair operations to increase freeboard and to protect the exposed embankment mate- rial. Start filling sandbags and stockpile near slide area.	Dozer, shovels, sources of fill material, sandbags	Distance between stakes
	Slide or erosion in-volving large mass of material, crest of embankment is de-graded, progressively increasing in size.	ORANGE	Continue monitoring and remedial actions as described above. Place additional mate- rial at the toe of the slope to stop the slide.	Dozer, shovels, source of fill mate-rial, pump	Distance between stakes
	Slide or erosion in-volving large mass of material, crest of embankment is severely degraded, movement of slide is continuing and may reach pool level.	RED	Downstream evacuation. Utilize all available equipment and personnel to sand- bag the degraded slide area to prevent it from overtop- ping.	Dozer, shovels, sandbags, pump	Distance between stakes
Sinkholes	Sinkholes anywhere on the embankment or within 150 metres downstream from the toe.	BLUE	Carefully walk the entire embankment and downstream area looking for additional sinkholes, movement, or seepage.	Stakes, flagging	Size, location

General observation	Specific observation	Emergency condition level	Emergency action	Equipment, material, and supplies	Data to record
	Sinkholes with corresponding seepage anywhere on the embankment or downstream from the toe.	BLUE	Initiate 24-hour surveillance. Monitor as above. Construct sandbag dike around the seepage exit point to reduce the flow rate. Start filling sandbags and stockpile near sinkhole.	Dozer, shovels, pump	Size, location
	Large sinkholes with corresponding seepage anywhere on the embankment or downstream from the toe.	ORANGE	Continue monitoring and remedial action as described above. Utilize sandbags to increase the freeboard on the dam if necessary.	Sandbags, dozer, pump	Size, location
	Sinkholes rapidly getting worse, seepage flowing muddy water and increasing flow.	RED	Downstream evacuation. Utilize all available equipment and personnel to attempt to construct a large ring dike around the area.	Dozer, shovels, pump	Size, location
Settlement	Obvious settlement of the crest of the embankment, especially adjacent to concrete structures.	BLUE	Look for bulges on slope or changes in crest alignment.	None	Size, location
	Settlement of crest of embankment that is progressing, especially adjacent to concrete structures or if any corresponding seepage is present.	BLUE	Initiate 24-hour surveillance. Mobilize all available resources for repair operations to increase freeboard. Fill and stockpile sandbags. Identify any boils near settlement points for flowing material and pursue action for boils.	Sandbags, dozer, shovels, source of fill material	Size, location
	Settlement of crest of embankment that is rapidly progressing especially adjacent to concrete structures or if any corresponding seepage is flowing muddy water or increasing flow.	ORANGE	Continue monitoring and remedial actions as described above. Use sandbags to increase the freeboard on the dam if necessary.	Sandbags, shovels, dozer, source of fill material	Size, location
	Progressing settlement that is expected to degrade the embankment to	RED	Downstream evacuation. Utilize all available equipment and personnel to build up the crest in the area that	Dozer, shovels, source of fill mate-	Size, location

General observation	Specific observation	Emergency condition level	Emergency action	Equipment, material, and supplies	Data to record
	reservoir level.		is settling. Identify any boils near settlement points for flowing material and pursue action for boils.	rial, sandbags	
Cracking	Cracks in the embankment crest or on slopes.	BLUE	Walk on entire crest and slope and check for additional cracking.	Stakes, tape measure	Size, location
	Numerous cracks in crest that are enlarging, especially those perpendicular to the centerline of the dam.	BLUE	Initiate 24-hour surveillance. Carefully monitor and measure cracking to determine the speed and extent of the problem. Mobilize to fill cracks. Cracks parallel to the centerline indicate a slide. Follow remedial action for slides.	Stakes, tape measure, dozer, shovels, source of fill material	Size, location
	Large cracks in the crest that are rapidly enlarging, especially those perpendicular to the centerline of the dam.	ORANGE	Continue monitoring and remedial action as described above.	Dozer, shovels, source of fill material	Size, location
	Cracking that extends to pool elevation.	RED	Downstream evacuation. Continue remedial actions as described above.	Dozer, shovels, source of fill material	Size, location
Cracking or movement of concrete structure	Minor cracking and/or movement.	BLUE	Immediately install measuring device to monitor movement.	Crack Monitors, stakes, tape measure	Size, location
	Significant cracking and /or movement.	BLUE	Initiate 24-hour surveillance. Lower burlap on upstream face of crack to reduce flow of soil particles. Dump large rock on downstream of moving concrete structure monolith to resist the movement.	Burlap, rock, dozer, shovels	Size, location, flow rate
	Serious cracking and /or movement	ORANGE	Prepare for evacuation. Continue monitoring and remedial action as described above.	Dozer, rock, burlap, crack monitors	Size, movement, flow rate
	Major cracking and /or movement	RED	Downstream evacuation. Dam failure is imminent.	Dozer, shovels,	Size, location,

General observation	Specific observation	Emergency condition level	Emergency action	Equipment, material, and supplies	Data to record
			Continue monitoring and remedial actions as described above.	rock	flow rate
Upstream whirlpool	Whirlpool in the lake in the vicinity of the embankment	RED	Downstream evacuation. Attempt to plug the entrance of the whirlpool with riprap from the slope of the embankment. Search downstream for an exit point and construct a ring dike to retard the flow of soil particles.	Dozer, fill material, sandbags, filter cloth, straw, rocks	Size, location, flow rate
Malfunction of gate	Structural member of a gate or gate operator broken or severely damaged so as to prevent operation of the gate	ORANGE	Initiate 24-hour surveillance. Immediately place stop logs in front of gate and initiate necessary actions to get gate repaired.	Crane and welder	Type of problem, location
Rapidly rising lake	Lake level rising and rain continuing	BLUE	Initiate 24-hour surveillance of lake level and rainfall. Generate inflow forecasts every 12 hours.		Lake level, rainfall
Overtopping	Water flowing over the dam and lake continuing to rise. No significant erosion of downstream embankment.	ORANGE	Prepare for evacuation. Continue monitoring. Generate inflow forecasts every 3 hours.	Dozer, fill material, sandbags, filter cloth, rocks	Lake level, rainfall
	Water flowing over the dam, the lake continuing to rise, and significant erosion of downstream embankment with development of head-cuts encroaching on the dam crest, or significant movement of sections of concrete or masonry portions of the dam.	RED	Immediate evacuation. Dam failure is imminent or ongoing.	Cameras.	Status of breach formation. Width of breach as it enlarges.

Tab 6

Supplies and Resources

The following equipment and supplies may be necessary for use during a dam emergency. Con- tact information for local contractors who can provide the following items during an emergency is listed below. For supplies owned by the dam owner, the dam owner's name and the specific location of the supplies have been denoted.

Equipment/Supplies	Location
Backhoes Dump trucks Portable welding equipment Generators Bulldozers Excavators Loaders Motor graders	JSW Energy Kutehr Limited
Crane	JSW Energy Kutehr Limited
Sandbags	JSW Energy Kutehr Limited
Rock riprap	JSW Energy Kutehr Limited
Fill Material	JSW Energy Kutehr Limited
Other:	JSW Energy Kutehr Limited

Tab 7

Annual EAP Evaluation Checklist

Was the annual dam inspection conducted?	□ Yes □ No	If yes, has the EAP been re- vised to include any signs of failures observed during the inspection?	□ Yes □ No
Was weed clearing, animal burrow removal, or other maintenance re- quired?	□ Yes □ No	If yes, describe actions taken and date:	
Was the outlet gate operable?	□ Yes □ No	If no, describe actions taken and date:	
Does the Notification Flowcharts require revision? (Note that revision of the contact information will not require EAP approval; however, the revised con- tact information pages will need to be redistributed as replacement pag- es.)	□ Yes □ No	If yes, list the dates of the contact information revision and redistribution:	
Was annual training or a tabletop drill conducted?	□ Yes □ No	Circle: training drill Date conducted:	
Are inspection and training records included in the EAP?	□ Yes □ No		
Was the EAP reviewed?	□ Yes □ No	If yes, review date:	
Were changes required to the EAP?	□ Yes □ No	If yes, date of revised EAP approval:	

_____ _____

[Name and Title of Appropriate Manager for Owner] Date

Tab 8

Plan Review and Update

This plan will be reviewed and updated annually and tabletop drills will be carried out at least once every five years. Document these reviews below.

Date of review: _____ Participants:

Date of review: _____ Participants:

Date of review: _____ Participants:

Date of review: _____ Participants:

Date of tabletop drill: ____ Participants:

Tab 9

Training Record

Use this form to record training sessions. File the completed form in the appropriate Tab of the EAP. All items in the EAP should be thoroughly reviewed during training. Appropriate [Dam Owner] employees and EAP team members should attend a training session annually (or participate in a simulated drill).

TRAINING LOCATION:	
DATE: TIME: INSTRUCTOR:	
CLASS SIGN-IN:	
Type of Simulation Conducted:	Circle Emergency Type: Emergency water release Watch condition Possible dam failure Imminent dam failure Actual dam failure
Comments, Results of Drill:	
Revisions Needed to EAP Based on Results of Drill? □ Yes □ No If yes, list revisions required:	

Appendix B. GLOSSARY OF TERMS FOR DAM SAFETY

Glossary of Terms for Dam Safety

The purpose of this glossary is to establish a common vocabulary of dam safety terms for use within and among Central and State Government agencies. Terms have been included that are generic and apply to all dams, regardless of size, owner, or location.

Abutment – The part of the valley side against which the dam is constructed. The left and right abutments of a dam are de- fined with the observer looking downstream from the dam.

Appurtenant work – Structures associated with the dam including the following:

a) Spillways, either in the dam or separate therefrom;
b) Reservoir and its rim;
c) Low-level outlet works and water conduits such as tunnels, pipelines or penstocks, either through the dam or its abutments or reservoir rim;
d) Hydro-mechanical equipment including gates, valves, hoists, and elevators;
e) Energy dissipation and river training works; and
f) Other associated structures acting integrally with dam body.

Auxiliary spillway – Any secondary spill- way that is designed to be operated in frequently, possibly in anticipation of some degree of structural damage or erosion to the spillway that would occur during operation.

Barrage – While the term barrage is borrowed from the French word meaning "dam" in general, its usage in English refers to a type of low-head, dam that consists of a number of large gates that can be opened or closed to control the amount of water passing through the structure, and thus regulate and stabilize river water elevation upstream for use diverting flow for irrigation and other purposes.

Boil – A disruption of the soil surface due to water discharging from below the surface. Eroded soil may be deposited in the form of a ring (miniature volcano) around the disruption.

Breach – An excavation or opening, either controlled or a result of a failure of the dam, through a dam or spillway that is capable of completely draining the reservoir down to the approximate original topography so the dam will no longer impound water, or partially draining the reservoir to lower im- pounding capacity. An uncontrolled breach is generally associated with the partial or total failure of the dam.

Breach analysis – The determination of the most likely uncontrolled release of water from a dam (magnitude, duration, and location), using accepted engineering practice, to evaluate downstream hazard potential.

Breach inundation area – An area that would be flooded as a result of a dam fail- ure.

Chimney drain – A vertical or inclined lay- er of pervious material in an embankment to facilitate and control drainage of the embankment fill.

Cofferdam – A temporary structure enclosing all or part of the construction area that construction can proceed in the dry. A di- version cofferdam diverts a stream into a pipe, channel, tunnel, or other watercourse.

Compaction – Mechanical action that in- creases soil density by reducing voids.

Concrete lift –The vertical distance be- tween successive horizontal construction joints.

Conduit – A closed channel to convey wa- ter through, around, or under a dam.

Construction joint – The interface between two successive placements or pours of concrete where bond, and not permanent separation, is intended.

Construction – Building a proposed dam and appurtenant structures capable of storing water.

Contact grouting – Filling, with cement grout, any voids existing at the contact of two zones of different materials, i.e., be-

tween a concrete tunnel lining and the surrounding rock.

Core wall – A wall built of relatively impervious material, usually of concrete or asphaltic concrete in the body of an embankment dam to prevent seepage.

Cutoff trench – A foundation excavation later to be filled with impervious material so as to limit seepage beneath a dam.

Cutoff wall – A wall of impervious material usually of concrete, asphaltic concrete, or steel sheet piling constructed in the foundation and abutments to reduce seepage be- neath and adjacent to the dam.

Dam – Any artificial barrier including appurtenant works constructed across rivers or tributaries thereof with a view to impound or divert water; includes barrage, weir and similar water impounding structures but does not include water conveyance structures such as canal, aqueduct and navigation channel and flow regulation structures such as flood embankment, dike and guide bund.

Dam failure – Failures in the structures or operation of a dam which may lead to uncontrolled release of impounded water resulting in downstream flooding affecting the life and property of the people.

Dam incident – All problems occurring to a dam that have not degraded into 'dam failure' and including the following:

a) Structural damage to the dam and appurtenant works;
b) Unusual readings of instruments in the dam;
c) Unusual seepage or leakage through the dam body;
d) Change in the seepage or leakage regime;
e) Boiling or artesian conditions noticed below an earth dam;
f) Stoppage or reduction in seepage or leakage from the foundation or body of the dam into any of the galleries, for dams with such galleries;
g) Malfunctioning or inappropriate operation of gates;
h) Occurrence of any flood, the peak of which exceeds the available flood discharge capacity or 70% of the ap- proved design flood;
i) Occurrence of a flood, which resulted in encroachment on the available freeboard, or the approved design freeboard;
j) Erosion in the near vicinity, up to five hundred meters, downstream of the spillway, waste weir, etc.; and
k) Any other event that prudence suggests would have a significant unfavorable impact on dam safety.

Dam inspection – On site examination of all components of dam and its appurtenances by one or more persons trained in this respect and includes examination of non-overflow portion, spillways, abutments, stilling basin, piers, bridge, downstream toe, drainage galleries, operation of mechanical systems (including gates and its components, drive units, cranes), interior of outlet conduits, instrumentation records and record-keeping arrangements of instruments.

Dam owner – The Central Government or a State Government or public sector undertaking or local authority or company and any or all of such persons or organizations who own, control, operate, or maintain a specified dam.

Dam safety – The practice of ensuring the integrity and viability of dams such that they do not present unacceptable risks to the public, property, and the environment. It requires the collective application of engineering principles and experience, and a philosophy of risk management that recognizes that a dam is a structure whose safe function is not explicitly determined by its original design and construction. It also includes all actions taken to identify or predict deficiencies and consequences related to failure, and to document, publicize, and reduce, eliminate, or remediate to the extent reasonably possible, any unacceptable risks.

Design water level – The maximum water elevation, including the flood surcharge, that a dam is designed to withstand.

Design wind – The most severe wind that is reasonably possible at a particular reservoir for generating wind setup and run-up. The determination will generally include the results of meteorological studies that com- bine wind velocity, duration, direction and seasonal distribution characteristics in realis- tic manner.

Diversion dam – A dam built to divert water from a waterway or stream into a different watercourse.

Earth-fill dam – An embankment dam in which more than 50% of the total volume is formed of compacted earth layers.

Effective crest of the dam – The elevation of the lowest point on the crest (top) of the dam, excluding spillways.

Embankment dam – Any dam constructed of excavated natural materials, such as both earth-fill and rock-fill dams, or of industrial waste materials, such as a tailings dam.

Embankment zone – An area or portion of an embankment dam constructed using similar materials and similar construction and compaction methods throughout.

Emergency action plan (EAP) – A writ- ten document prepared by the dam owner or the owner's professional engineer de- scribing a detailed plan to prevent or lessen the effects of a failure of the dam or appurtenant structures.

Emergency condition level – The following three emergency condition levels are considered:

1. **BLUE** – An event has taken place that is developing slowly and needs to be monitored closely. Immediate correction action is required.
2. ORANGE – Dam failure is highly probable but might be avoided with corrective actions.
3. **RED** – Dam failure is imminent or ongoing.

Emergency repairs – Any repairs that are considered to be temporary in nature and that are necessary to preserve the integrity of the dam and prevent a possible failure of the dam.

Emergency spillway – An auxiliary spill- way designed to pass a large, but infrequent, volume of flood flow, with a crest elevation higher than the principal spillway or normal operating level.

Failure mode – A potential failure mode is a physically plausible process for dam failure resulting from an existing inadequacy or defect related to a natural foundation condition, the dam or appurtenant structures de- sign, the construction, the materials incorporated, the operations and maintenance, or aging process, which can lead to an uncontrolled release of the reservoir.

Fetch – The-straight-line distance across a body of water subject to wind forces. The fetch is one of the factors used in calculating wave heights in a reservoir.

Filter – One or more layers of granular material graded (either naturally or by selection) so as to allow seepage through or within the layers while preventing the migration of material from adjacent zones.

Flap gate – A gate hinged along one edge, usually either the top or bottom edge. Examples of bottom-hinged flap gates are tilting gates and fish belly gates so called from their shape in cross section.

Flashboards – Structural members of timber, concrete, or steel placed in channels or on the crest of a spillway to raise the reservoir water level but intended to be quickly removed, tripped, or fail in the event of a flood.

Flip bucket – An energy dissipater located at the downstream end of a spillway and shaped so that water flowing at a high velocity is deflected upwards in a trajectory away from the foundation of the spillway.

Flood hydrograph – A graph showing, for a given point on a stream, the discharge, height, or other characteristic of a flood with respect to time.

Freeboard – Vertical distance between a specified Stillwater (or other) reservoir sur-

face elevation and the top of the dam, without camber.

Gabion – Rectangular-shaped baskets or mattresses fabricated from wire mesh, filled with rock, and assembled to form overflow weirs, hydraulic drops, and overtopping protection for small embankment dams. Gabion baskets are generally stacked in a stair-stepped fashion, while mattresses are generally placed parallel to a slope. Gabions have advantages over loose riprap because of their modularity and rock confinement properties, thus providing erosion protection with less rock and with smaller rock sizes than loose riprap.

Gallery – A passageway in the body of a dam used for inspection, foundation grouting, and/or drainage.

Gate – A movable water barrier for the control of water.

Geomembrane – An essentially impermeable geosynthetic composed of one or more synthetic sheets.

Geosynthetic – A planar product manufactured from polymeric material used with soil, rock, earth, or other geotechnical engineering related material as an integral part of a man-made project, structure, or system.

Geotextile – Any fabric or textile (natural or synthetic) when used as an engineering material in conjunction with soil, foundations, or rock. Geotextiles have the following uses: drainage, filtration, separation of materials, reinforcement, moisture barriers, and erosion protection.

Gravity dam – A dam constructed of concrete and/or masonry that relies on its weight and internal strength for stability.

Grout – A fluidized material that is injected into soil, rock, concrete, or other construction material to seal openings and to lower the permeability and/or provide additional structural strength. There are four major types of grouting materials: chemical; cement; clay; and bitumen.

Grout blanket – An area of the foundation systematically grouted to a uniform shallow depth.

Grout cap – A concrete filled trench or pad encompassing all grout lines constructed to impede surface leakage and to provide anchorage for grout connections.

Grout curtain – One or more zones, usually thin, in the foundation into which grout is injected to reduce seepage under or around a dam.

Hazard potential – The possible adverse incremental consequences that result from the release of water or stored contents be- cause of failure or incorrect operation of the dam or appurtenances. Impacts may be for a defined area downstream of a dam from flood waters released through spillways and outlet works of the dam or waters released by partial or complete failure of the dam. There may also be impacts for an area up- stream of the dam from effects of backwater flooding or landslides around the reservoir perimeter.

Hazard potential classification – A measure of the potential for loss of life, property damage, or economic impact in the area downstream of the dam in the event of a failure or malfunction of the dam or appurtenant structures. The hazard classification does not represent the physical condition of the dam.

Height of dam – The difference in elevation between the natural bed of the water- course or the lowest point on the down- stream toe of the dam, whichever is lower, and the effective crest of the dam.

Hydraulic fracturing – Hydraulic fracturing in soils is a tensile parting that is created because of increased fluid pressure. Initiation and/or propagation cracks in the core sections of earthen dams because of hydraulic fracturing affect adversely structural safe- ty of the dams.

Hydraulic gradient – The change in total hydraulic pressure per unit distance of flow.

Hydrology – One of the earth sciences that encompasses the natural occurrence, distribution, movement, and properties of

the waters of the earth and their environmental relationships.

Hydrometeorology – The study of the atmospheric and land-surface phases of the hydrologic cycle with emphasis on the inter-relationships involved.

Hydrostatic pressure – The pressure exerted by water at rest.

Inclinometer – An instrument, usually consisting of a metal or plastic casing inserted in a drill hole and a sensitive monitor either lowered into the casing or fixed within the casing. This measures at different points the casing's inclination to the vertical. The system may be used to measure settlement.

Inflow design flood –The flood hydro-graph used in the design of a dam and its appurtenant works particularly for sizing the spillway and outlet works and for determining maximum storage, height of dam, and freeboard requirements.

Instrumentation – An arrangement of de-vices installed into or near dams that pro- vide for measurements that can be used to evaluate the structural behavior and performance parameters of the structure.

Internal erosion – A general term used to describe all of the various erosional process-es where water moves internally through or adjacent to the soil zones of embankment dams and foundation, except for the specific process referred to as 'backward erosion piping'. The term internal erosion is used in place of a variety of terms that have been used to describe various erosional processes, such as scour, suffusion, concentrated leak piping, and others.

Inundation map – A map showing areas that would be affected by flooding from re- leases from a dam's reservoir. The flooding may be from either controlled or uncontrolled releases or as a result of a dam failure. A series of maps for a dam could show the incremental areas flooded by larger flood releases. For breach analyses, this map should also show the time to flood arrival, and maximum water-surface elevations and flow rates.

Large dam – A dam which is above 15 m in height, measured from the lowest portion of the general foundation area to the top of dam; or a dam between 10 m to 15 m in height and that satisfies at least one of the following, namely

a) The length of crest is not less than 500 m;
b) The capacity of the reservoir formed by the dam is not less than one million cubic meters;
c) The maximum flood discharge dealt with by the dam is not less than 2000 m^3/s;
d) The dam has particularly difficult foundation problems; or
e) The dam is of unusual design.

Liquefaction – A condition whereby soil undergoes continued deformation at a constant low residual stress or with low residual resistance, due to the buildup and maintenance of high pore-water pressures, which reduces the effective confining pressure to a very low value. Pore pressure buildup leading to liquefaction may be due either to static or cyclic stress applications and the possibility of its occurrence will depend on the void ratio or relative density of a cohesion- less soil and the confining pressure.

Loss of life – Human fatalities that would result from a failure of the dam, without considering the mitigation of loss of life that could occur with evacuation or other emergency actions.

Low level outlet (bottom outlet) – An opening at a low level from a reservoir generally used for emptying or for scouring sediment and sometimes for irrigation releases.

Maintenance – Those tasks that are generally recurring and are necessary to keep the dam and appurtenant structures in a sound condition and free from defect or damage that could hinder the dam's functions as de-signed, including adjacent areas that also could affect the function and operation of the dam.

Maintenance inspection – Visual inspection of the dam and appurtenant structures by the owner or owner's representative to detect apparent signs of deterioration, other deficiencies, or any other areas of concern.

Masonry dam – Any dam constructed mainly of stone, brick, or concrete blocks pointed with mortar. A dam having only a masonry facing should not be referred to as a masonry dam.

Maximum storage capacity – The volume, in millions of cubic metres (Mm^3), of the impoundment created by the dam at the effective crest of the dam; only water that can be stored above natural ground level or that could be released by failure of the dam is considered in assessing the storage volume; the maximum storage capacity may decrease over time due to sedimentation or increase if the reservoir is dredged.

Maximum wind – The most severe wind for generating waves that is reasonably possible at a particular reservoir. The determination will generally include results of meteorological studies that combine wind velocity, duration, direction, fetch, and seasonal distribution characteristics in a realistic manner.

Meteorology – The science that deals with the atmosphere and atmospheric phenomena, the study of weather, particularly storms and the rainfall they produce.

Normal storage capacity – The volume, in millions of cubic metres (Mm^3), of the impoundment created by the dam at the lowest uncontrolled spillway crest elevation, or at the maximum elevation of the reservoir at the normal (non-flooding) operating level.

Outlet – A conduit or pipe controlled by a gate or valve, or a siphon, that is used to release impounded water from the reservoir.

Outlet gate – A gate controlling the flow of water through a reservoir outlet.

Outlet works – A dam appurtenance that provides release of water (generally controlled) from a reservoir.

Parapet wall – A solid wall built along the top of a dam (upstream or downstream edge) used for ornamentation, for safety of vehicles and pedestrians, or to prevent over- topping caused by wave runup.

Peak flow – The maximum instantaneous discharge that occurs during a flood. It is coincident with the peak of a flood hydrograph.

Penstock – A pressurized pipeline or shaft between the reservoir and hydraulic machinery.

Phreatic surface – The free surface of water seeping at atmospheric pressure through soil or rock.

Piezometer – An instrument used to measure water levels or pore water pressures in embankments, foundations, abutments, soil, rock, or concrete.

Piping – The progressive development of internal erosion by seepage.

Plunge pool – A natural or artificially created pool that dissipates the energy of free-falling water.

Pressure relief pipes – Pipes used to relieve uplift or pore water pressure in a dam foundation or in the dam structure.

Probable Maximum Flood – The flood that may be expected from the most severe combination of critical meteorological and hydrologic conditions that are reasonably possible in the drainage basin under study.

Probable Maximum Precipitation – Theoretically, the greatest depth of precipitation for a given duration that is physically possible over a given size storm area at a particular geographical location during a certain time of the year.

Principal spillway – The primary or initial spillway engaged during a rainfall runoff event that is designed to pass normal flows.

Proposed dam – Any dam not yet under construction.

Radial gate – A gate with a curved up- stream plate and radial arms hinged to piers or other supporting structure. Also known as tainter

gate.

Repairs – Any work done on a dam that may affect the integrity, safety, and operation of the dam.

Reservoir – Any water spread which contains impounded water.

Reservoir Storage – The retention of water or delay of runoff in a reservoir either by planned operation, as in a reservoir, or by temporary filling in the progression of a flood wave. Specific types of storage in reservoirs are defined as follows:

a) Active storage – The volume of the reservoir that is available for some use such as power generation, irrigation, flood control, water supply, etc. The bottom elevation is the minimum operating level.
b) Dead storage – The storage that lies below the invert of the lowest outlet and that, therefore, cannot readily be withdrawn from the reservoir.
c) Flood surcharge – The storage volume between the top of the active storage and the design water level.
d) Inactive storage – The storage volume of a reservoir between the crest of the invert of the lowest outlet and the minimum operating level.
e) Live storage – The sum of the active- and the inactive storage.
f) Reservoir capacity – The sum of the dead and live storage of the reservoir.
g) Surcharge – The volume or space in a reservoir between the controlled retention water level and the maximum water level. Flood surcharge cannot be retained in the reservoir but will flow out of the reservoir until the controlled retention water level is reached.

Riprap – A layer of large rock, precast blocks, bags of cement, or other suitable material, generally placed on an embankment or along a watercourse as protection against wave action, erosion, or scour.

Risk analysis – A procedure to identify and quantify risks by establishing potential failure modes, providing numerical estimates of the likelihood of an event in a specified time period, and estimating the magnitude of the consequences. The risk analysis should include all potential events that would cause unintentional release of stored water from the reservoir.

Risk assessment – The process of deciding whether existing risks are tolerable and present risk control measures are adequate and, if not, whether alternative risk control measures are justified. Risk assessment in- corporates the risk analysis and risk evaluation phases.

Rock anchor – A steel rod or cable placed in a hole drilled in rock, held in position by grout, mechanical means, or both. In principle, the same as a rock bolt, but usually the rock anchor is more than 4 meters long.

Rock bolt – A tensioned reinforcement element consisting of a steel rod, a mechanical or grouted anchorage, and a plate and nut for tensioning or for retaining tension ap- plied by direct pull or by torquing.

Rock reinforcement – The placement of rock bolts, un-tensioned rock dowels, pr-stressed rock anchors, or wire tendons in a rock mass to reinforce and mobilize the rock's natural competency to support itself.

Rock-fill dam – An embankment dam in which more than 50% of the total volume is comprised of compacted or dumped cobbles, boulders, rock fragments, or quarried rock generally larger than 3-inch size.

Roller compacted concrete dam – A concrete gravity dam constructed by the use of a dry mix concrete transported by conventional construction equipment and compacted by rolling, usually with vibratory rollers.

Rubble dam – A stone masonry dam in which the stones are not shaped or coursed.

Saddle dam (or dike) – A subsidiary dam of any type constructed across a saddle or low point on the perimeter of a reservoir.

Safe manner – Operating and maintaining a dam in sound condition, free from defect or

damage that could hinder the dam's functions as designed.

Scour – The loss of material occurring at an erosional surface, where a concentrated flow is located, such as a crack through a dam or the dam/foundation contact. Continued flow causes the erosion to progress, creating a larger and larger eroded area.

Seepage – The internal movement of water that may take place through a dam, the foundation or the abutments, often emerging at ground level lower down the slope.

Seiche – An oscillating wave in a reservoir caused by a landslide into the reservoir or earthquake-induced ground accelerations or fault offset or meteorological event.

Settlement – The vertical downward movement of a structure or its foundation.

Sinkhole – A depression, indicating subsurface settlement or particle movement, typically having clearly defined boundaries with a sharp offset.

Significant wave height – Average height of the one-third highest individual waves. May be estimated from wind speed, fetch length, and wind duration

Siphon – An inverted U-shaped pipe or conduit, filled until atmospheric pressure is sufficient to force water from a reservoir over an embankment dam and out of the other end.

Slide – Movement of a mass of earth down a slope on the embankment or abutment of a dam.

Slide gate – A gate that can be opened or closed by sliding in supporting guides.

Spillway – A structure over or through which flow is discharged from a reservoir. If the rate of flow is controlled by mechanical means, such as gates, it is considered a con- trolled spillway. If the geometry of the spillway is the only control, it is considered an uncontrolled spillway.

Stilling basin – A basin constructed to dissipate the energy of rapidly flowing water, e.g., from a spillway or outlet, and to protect the riverbed from erosion.

Stillwater level – The elevation that a water surface would assume if all wave actions were absent.

Stoplogs – Large logs, timbers, or steel beams placed on top of each other with their ends held in guides on each side of a channel or conduit so as to provide a cheap- er or more easily handled means of temporary closure than a bulkhead gate.

Toe drain – A system of pipe and/or pervious material along the downstream toe of a dam used to collect seepage from the foundation and embankment and convey it to a free outlet.

Toe of dam – The junction of the down- stream slope or face of a dam with the ground surface; also referred to as the downstream toe. The junction of the up- stream slope with ground surface is called the heel or the upstream toe.

Top thickness (top width) – The thick- ness or width of a dam at the level of the top of dam (excluding corbels or parapets). In general, the term thickness is used for gravity and arch dams, and width is used for other dams.

Trash rack – A device located at an intake to prevent floating or submerged debris from entering the intake.

Uplift – The hydrostatic force of water exerted on or underneath a structure, tending to cause a displacement of the structure.

Vicinity map – A map that shows the location of the dam and surrounding roads that provide access to the dam. This map should display the location of the dam in relation to major roads and streets, and should include a north arrow and scale bar.

Volume of dam – The total space occupied by the materials forming the dam structure computed between abutments and from top to bottom of dam. No deduction is made for small openings such as galleries, adits, tunnels, and operating chambers within the dam structure. Portions of power plants,

locks, spillway, etc., are included only if they are needed for structural stability of the dam.

Watershed – The area drained by a river or river system or portion thereof. The watershed for a dam is the drainage area upstream of the dam.

Watershed divide – The divide or boundary between catchment areas (or drainage areas).

Wave protection – Riprap, concrete, or other armoring on the upstream face of an embankment dam to protect against scouring or erosion due to wave action.

Wave runup – Vertical height above the still water level to which water from a specific wave will run up the face of a structure or embankment.

Weir – A barrier across a stream designed to alter its flow characteristics. In most cases, weirs take the form of obstructions smaller than conventional dams, pooling water behind them while also allowing it to flow steadily over their tops.

Weir, broad-crested – An overflow structure on which the nappe is supported for an appreciable length in the direction of flow.

Weir, measuring – A device for measuring the rate of flow of water. It generally con- sists of a rectangular, trapezoidal, triangular, or other shaped notch, located in a vertical, thin plate over which water flows. The height of water above the weir crest is used to determine the rate of flow.

Weir, ogee – A reverse curve, shaped like an elongated letter "S." The downstream faces of overflow spillways are often made to this shape.

Wind setup – The vertical rise in the still-water level at the face of a structure or embankment caused by wind stresses on the surface of the water.

Kutehr HEP (240 MW)

Project ID Code - HP173MH0029

Approval and Implementation

This Emergency Action Plan is hereby approved. This plan is effective immediately and supersedes all previous editions.

Ajay Nath
AVP & Head of Plant (HOP)
JSW Energy (Kutehr) Limited

Date

I have received a copy of this Emergency Action Plan and concur with the notification procedures.

_____

[Signature(s)]

_____ _____

[Name and Title of Person(s) in charge of Emergency Response] Date