STANDARD OPERATING PROCEDURE (SOP) ON AVERTING THREATS EMANATING FROM LANDSLIDE DAMS (LSD) ON RIVERS IN MOUNTAINOUS REGIONS

General

1. The entire Himalayan Region is considered to be vulnerable to high intensity earthquakes of magnitude 7 and above on the Richter Scale. In a relatively short span of about 100 years, four such earthquakes have occurred : Shillong 1897 (8.7), Kangra 1905 (8.0), Bihar-Nepal 1934 (8.3) and Assam-Tibet 1950 (8.6). Scientific publications have warned that very severe earthquakes are likely to occur with increasing frequency in the Himalayan Region in the future.

2. Earthquakes in the Himalayan Region are the major cause of Landslide Dams (LSD). A LSD is the natural damming of a river by some kind of mass wasting. The water impounded by a LSD may create a dam reservoir that may last for a short duration to several hundred years. Because of their rather loose nature and absence of controlled spillway, LSD frequently fail catastrophically and lead to flooding often with high casualties. A common failure scenario is overflowing with subsequent dam breach and erosion by the overflow stream. In 1786, a LSD on River Dadu in China burst causing a flood that extended 1400 km downstream and killed over 100,000 people.

3. LSD can also occur when the stability of the slope of a mountain changes from a stable to unstable condition. One such incident in recent times was the Phuktal River LSD which was formed around 31 Dec. 2014 and was successfully managed by the Expert Team created by the NDMA with not a single loss of life or livestock.

4. Post this incident, a need was felt to prepare a Standard Operating Procedure (SOP) on averting threats emanating from Landslide Dams (LSD) on rivers in mountainous regions in order to ensure speedy and appropriate response by various agencies so that the threat is mitigated/eliminated.

5. This SOP lays down guidelines and action to be taken by various agencies during the different phases of the disaster. These are given in succeeding paragraphs.

Pre Operational Phase

6. The following activities need to be carried out:-

a. Ensure continuous monitoring of the quantity of water flow of all major rivers in the upper reaches by all possible means i.e. visual, instrumental, satellite photographs. (District Admin/ National Remote Sensing Centre (NRSC)/Central Water Commission (CWC)).

b. In case of reduced flow, ascertain the cause at the earliest through satellite / aerial and physical means. (State Admin/ NRSC)

c. Convene a meeting at Dist/State level to tackle the issue. Inform NDMA and provide regular updates. (State Admin).

d. Seek all possible inputs from Indian Meteorological Division (IMD), Snow & Avalanche Study Establishment (SASE), CWC, Survey of India (SoI) etc to facilitate decision making. (State Admin).

e. Refer the situation to National Disaster Management Authority (NDMA) if it is beyond the capability/resources of State Govt. (State Admin/ NDMA).

f. National Crisis Management Committee (NCMC) to convene a meeting at the earliest depending upon the severity of the situation. Simultaneously, the Defence Crisis Management Group (DCMG) meeting may also be held if required. (Cabinet Secretariat/ NDMA/ Ministry of Defence (MoD)).

g. NDMA / SDMA to activate the Control Rooms and update all records. Establish telephonic and video contact with all concerned officials including officials of the concerned State Control Room, IMD, CWC, NRSC and National Technical Research Organization (NTRO) obtain satellite images of the affected area. NDRF / SDRF alerted to be on standby. (NDMA/ SDMA (State Admin) / National Disaster Response Force (NDRF)/ NRSC/ NTRO/ IMD/ CWC).

h. Based on the outcome of the NCMC meeting, the affected State to organize a Team of Experts from those agencies which are likely to be involved. These could be some or all of the following:- (NDMA/ State Admin).

(i) Central Water Commission (CWC)
(ii) India Metrological Department (IMD)
(iii) Survey of India (SOI)
(iv) Geological Survey of India (GSI)
(v) Central Institute of Mining & Fuel Research (CIMFR)
(vi) Snow & Avalanche Study Establishment (SASE)
(vii) Border Roads Organization (BRO)
(viii) MoD / Integrated Defence Staff (IDS)
(vii) Hydro Power Developers
(ix) Dept of Science & Technology (Suitable representative from State Govt.)
(x) Official media personnel.
(xi) Other Departments.

j. State Govt to take immediate precautionary and preventive measures to ensure safety to life and property. These include :-

(i) Informing the populace living both down/upstream of the impending danger.
(ii) Installing water monitoring gauges at suitable locations.
(iii) Preparing (rehabilitation) relocation plans.
(iv) Establishing communication facilities at the likely affected areas.
(v) Alerting and preventing locals/ tourists not to venture into affected areas by establishing check posts/ check points.
(vi) Erecting banners/ boards with warning signs.
(vii) Taking immediate steps to relocate personnel from high risk zones.

k. CWC to prepare flood inundation/DEM Chart to indicate level of potential threat in the event of the dam break/overflow scenario. The inputs to be disseminated to all concerned. (CWC)

l. The Expert Team/essential members to conduct an on the spot assessment of the LSD and carry out recce to ascertain:-

(i) Free board available i.e. difference between current water level and LSD height.

(ii) Type and texture of landslide debris.

(iii) Possible time available before a sudden dam break.

(iv) Seepage towards downstream if any.

(v) Any threat likely to develop due to impounded water.

(vi) If intervention is required, then alignment and dimension of channel required to be created to be worked out.

(vii) How the channel is to be created, i.e. by using earth movers or manual clearing of debris (where earth movers cannot be deployed).

(viii) Can explosives be used for creating of channel? If so, resources required i.e. manpower, equipment, explosives, etc.

(ix) Any specific requirement which may be area/ region specific.

(x) Photography and videography of the site and surrounding areas.

m. Expert Team set up by NDMA / SDMA to assist State in preparing a detailed action plan giving out:-

(i) Transportation

(ii) Communication

(iii) Medical

(iv) Safety

(v) Logistics stocking, replenishment and reserves

(vi) Induction, execution and de-induction phases

(vii) Media plan, photography & videography of events

n. Conduct dry rehearsals / drills and carry out comprehensive check of all equipment. (Expert Team Leader)

Operational Phase

7. This phase involves:-

a. Securing and establishment of camp site and forward staging areas. (Army/ State Admin)

b. Establishing communication facilities at the site, staging areas and District Control Room. (Army/ State Admin)

c. Installing of Automatic Water Level Recorders (AWLR) and Water Gauges at the identified places downstream. CWC may assist. (State Admin/ CWC)

d. Installing safety devices like anchors, ropes, harnesses etc where required. (Army/ State Admin)

e. Stocking of logistics like ration, equipments and machines, fuel, medicines, explosives and accessories, lighting arrangements. (Army/ State Admin/ BRO)

f. Relocating the likely affected people from low lying areas at least 48 hrs before actual commencement of work at site if not done earlier. (District Admin/ Affected org)

g Detail a lookout Team to alert members at the worksite from falling stones, loose land mass etc. (Expert team leader)

h. Marking the alignment of the channel to be created at the blockage site. (Expert team leader)

i. Controlled use of explosives to break boulders/ dislodge compacted earth mass. Expertise of CIMFR, SASE, BRO & Army Engineers and others may be sought for use of explosives. (Army, BRO, Explosive Experts in State).

j. Manual clearing of debris along the marked alignment. (Expert team leader)

k. Manual clearing of debris and use of explosives can be alternately followed until the desired width, depth and length of channel is created for free flow of impounded water. (Expert team leader)

l. Use of earth movers (JCB) if it is possible to reach them at the site. These can even be dismantled in parts, carried by helicopters under slung and assembled at the site (As done during River Sunkoshi blockage in 2014). (Air force/ Army Engineers/ State Admin)

m. Loose debris can even be washed away using high pressure water jets at places subject to deployment of heavy duty compressors. (State Admin/ Army)

n. Photography and videography of events for future reference. Representatives of media should be associated. (State Admin/ Expert Team Leader)

o. Ambulance / helicopter on call to respond to any distress call. (Air force/ State Admin)

p. Obtain daily weather reports to plan for next day's activity. (Team leader/ Air Force / IMD).

q. Media briefing and press release at the end of the day's activity by the designated representative of State associated with the team. (State / Dist Admin/ NDMA/ Army PRO)

Post Operational Phase

8. The following activities need emphasis:-

a. Round the clock monitoring from the Lookout Post till the situation normalises. (State Admin/ Army)

b. Monitoring of water level downstream through AWLR or water gauges. (State Admin/ CWC)

c. Obtain satellite imageries, from NRSC & NTRO to compare pre and post activity changes in volume of impounded water upstream, status of flow of water through channel and flow of water downstream. (State Admin/ CWC/NRSC/NTRO/NDMA)

d. Periodical aerial recee and videography of the site where the site has no connectivity to know the latest status. (State Admin/ Army/ Airforce/ Expert Team)

e. Decide on safety of habitation for return of population once impounded water has drained out. CWC can assist in advising the safe levels. (State Admin/ GSI / CWC/ NRSC/ NTRO).

f. Ideally all bridges (Foot, Vehicular, Suspension) should be at a sufficient height above the river bed to cater for an abnormal surge of water. State PWD should have a plan to dismantle posts of suspension/ foot over bridges in such a scenario. (State PWD)

g. In cases where Dam has breached, Post Breach Analysis and Assessment by team of experts shall be carried out and further course of action recommended. (State Admin)

h. All concerned / involved Ministries and Govt. organizations must ensure they have adequate well trained experts so that they can be speedily moved to the disaster site. (Action by - State Admin/ CWC/SASE/GSI/SOI/BRO/CIMFR)

i. Compendium of recommendations and lessons learnt shall be drawn and shared with all concerned agencies / Depts. (State Admin/ Expert Team Leader)

Conclusion

9. The entire Himalayan Region lies in Seismic Zone V, thus making it very prone to frequent earthquakes. There are a large number of rivers which flow in these upper reaches making them extremely vulnerable to LSD in the event of an earthquake.

10. The SOP on "Averting Threats Emanating from Landslide Dams (LSD) on Rivers in Mountainous Regions" gives out detailed actions / steps to be taken by respective authorities in the event of a LSD. It is, by no means, exhaustive but a referral document which needs periodical modification with sharing of experiences and best practices across the country.