National Committee on Seismic Design Parameters (NCSDP) for River Valley Projects

MINUTES OF 29th MEETING (Extraordinary Meeting)

(19th May, 2015)

Secretariat

Foundation Engineering & Special Analysis (FE&SA) Directorate
Central Water Commission
New Delhi

Minutes of the 29th Meeting (Extraordinary meeting) of National Committee on Seismic Design Parameters (NCSDP) for River Valley Projects held on 19th May, 2015 in CWC, New Delhi

29.1 General:

The 29th meeting (extraordinary Meeting) of the National Committee on Seismic Design Parameters (NCSDP) for River Valley Projects was held on 19th May, 2015 at 1100 hrs in the Conference Room, Central Water Commission, New Delhi to discuss the causes, features and effects of Nepal earthquake and subsequent aftershocks; necessity of any proactive plan and other related issues. Sh. C K Agrawal, Member (D&R), CWC chaired the meeting. Sh A. B. Pandya, Chairman Central Water Commission also attended the meeting as a special Invitee. The list of Members and invitees who attended the meeting is given at ***Annexure I***.

Meeting commenced with Sh. C. K. Agrawal, Chairman, NCSDP welcoming the participants of the meeting followed by a brief introduction of the participants. The Chairman highlighted the purpose of extraordinary meeting in the aftermath of Nepal earthquake.

Before taking up the Agenda items Chairman NCSDP requested Sh. A. B. Pandya, Chairman, Central Water Commission to address the Committee. Chairman, CWC mentioned that the recent earthquake in Nepal and its consequences in both Nepal and India have underlined the urgency for a Standard Operating Procedure (SOP) to handle any unforeseen emergencies on account of damages induced by the earthquake on the dams in near vicinity of its epicentre. He emphasized that immediate assessment of the hazard potential of the earthquake vis-à-vis such dams near the epicentre is very much essential so as to take care any extra threat to the safety of dams in post earthquake scenario. Thereafter, Member Secretary, NCSDP was requested to take up the agenda item for discussion.

29.2 Agenda Items for discussion:

29.2.1 Understanding the causes, features and effects of Nepal earthquake and subsequent aftershocks:

Member Secretary requested Sh P R Baidya, representative from IMD to provide his input on the causes, features and effects of Nepal earthquake and subsequent aftershocks. In response, Sh, Baidya informed the Committee that the earthquake was a typical Himalayan earthquake which have occurred due to thrust faulting between the subducting India plate and the overriding Eurasia plate. The occurrence of earthquakes in the region is mainly attributed to various geological & tectonic features, such as Main Boundary Thrust (MBT), Main Central Thrust (MCT), and some other transverse faults in the Himalayan region.

During discussion Sh Baidya also mentioned that from the available geological and seismological evidences, it is seen that these faults have been found to be active in the past. According to the theory of regional plate tectonics, the area lies near the boundary of Indian and Eurasian plates along which there is a wide zone of deformation due to cracking and splintering of the lithosphere and is characterized by single dominant direction of under - thrusting. Geophysical data in and around Himalayas have shown that the Indian plate is moving in a northeast ward direction at an average rate of 5 cm per year due to which tremendous amount of strain is accumulating in the region. The strain so accumulated is occasionally released through earthquakes all along the foothills of the Himalayas as seen one in the recent Nepal earthquake.

Sh Baidya informed the Committee that the preliminary hypo-central parameters of this earthquake, as estimated by the National Seismological Network are given below:

Date of occurrence:	25/04/2015
Time :	11:41 hrs (IST)
Magnitude:	7.9
Focal depth:	10 Km
Epiecentre : (Latitude & Longitude)	28.1^0 N & 84.6^0 E
Region:	Nepal (about 80 Km NW of Kathmandu)

The event was reported severely felt in all northern, eastern and many parts of central parts of India. This earthquake has caused major damage in the epicentral region and surrounding areas in Nepal including Kathmandu as well some areas in India in UP and Bihar. The intensity in the source region of this earthquake is expected to be of IX and above at Modified Mercalli Intensity scale (MMI). Sh Baidya also mentioned that the Nepal main event was followed by number of aftershocks which includes two largest aftershocks of Magnitude 6.9 on 26th April, 2015 and Magnitude 7.3 on 12th May, 2015. Till 18th May, 2015, a total of 155 numbers of significant aftershocks have been detected and located by national seismological network including 24 aftershocks of magnitude 5 and above. However, many hundreds of smaller aftershocks might have also occurred in the rupture zone of the main event, and the aftershock activities are still continuing.

Dr M.L. Sharma, IIT Roorkee was of the opinion that occurrence of after shock activities have many reasons. Aftershock gives the adjustment to the main event. He also expressed his opinion that the earthquake of Magnitude 7.3 on 12th May, 2015 may be an independent earthquake; but this view was not agreed by all Members.

Sh. D. Srinagesh, representative from NGRI mentioned that the location, size and focal mechanism of the 25th April, 2015 earthquake and aftershocks are consistent with its occurrence on the decollément associated with the Main Himalayan Thrust, which defines the subduction thrust interface between the India and Eurasia plates. He also mentioned that while commonly plotted as points on maps, earthquakes of this size are more appropriately described as slip over a larger fault area. Events of the size of the April 25, 2015 earthquake are typically about 100x50 km in size (length x width); early modeling of this earthquake implies dimensions of ~120x80 km, directed from the hypocenter eastwards, and towards Kathmandu. As a result, substantial seismic energy was generated by faulting very close to the city. He further informed the Committee that the boundary region of the India and Eurasia plates has a history of large and great earthquakes. Four events of Magnitude 6 or larger have occurred within 250 km of the April 25, 2015 earthquake over the past century. An earthquake of Magnitude 6.9 in August 1988, 240 km to the southeast of the April 25 event has occurred. The largest, Magnitude 8.0 event known as the 1934 Nepal-Bihar earthquake, ruptured a large

section of the fault to the east of this 2015 event, in a similar location to the 1988 earthquake. Prior to the 20th century, a large earthquake in 1833 is thought to have ruptured a similar area as the 2015 event. The Indian seismological stations within a radius of the 1000-1500 km from the epicentre of the 25th April 2015 have indicated the PGA values are larger in the direction of the rupture, indicating the directivity effect. The accelerations vary from .05g to as small as 0.002 g. However, for the aftershocks it is clearly evident that the local sites are responsible for the amplification of the ground motion.

Sh Niroj Sarkar, representative from GSI has mentioned that the causes of the Nepal earthquakes (Main shocks and aftershocks) can be explained in terms of stress build and their distribution along the junctions of E-W trending regional thrusts and that N-S trending lineaments (such as Gauri Shankar lineaments). The large number of aftershocks can be explained in terms of the distribution from the source fault (main shocks) to adjacent faults. Responding to a query from Dr. B.R. K. Pillai, Director, CWC, he further informed that the identification of the surface expression of the rupture plane (if any) through remote sensing and field based studies can be explored as a part of the geological input during DPR preparation River valley projects along with identification of active faults/lineaments and mapping of the same.

The Committee noted the information provided by the various Members.

29.2.2 Necessity of any proactive action plan or reprioritization of plans in light of Nepal earthquake

During discussion, Sh. D. Srinagesh, NGRI mentioned that Instrumentation has to be strengthened for major dams in the Himalayan region. Seismological and GPS instruments have to be installed on an urgent basis for all the dams in Seismic Zone V and Seismic Zone IV especially within Himalayas and foot hills of Himalaya such as the Indo Gangetic plains. The data from critical sites should be transmitted in real time in order to estimate the ground motion accelerations. Recording of ground motions from various earthquake sources shall help in understanding the behaviour of the ground motion and associated response spectra.

Sh. Baidya, IMD mentioned that we may get available acceleration/other ground motion data recorded at various dams during the Nepal earthquake which may be useful for future study on safety of dams. He also suggested taking stock of the availability of seismic instruments at all important dams, particularly in Himalaya region and consider for improvement of instrumentation (displacement, velocity and acceleration instruments as well as GPS observations) at these dams and all upcoming dams.

Dr. M. L. Sharma, IIT Roorkee mentioned that the strong motion data collection is far less than the objectives in this region and there is a need to upgrade the existing stations and deploy more instrumentation in the region. For the purpose, he was of the view to strengthen the instrumentation part in the existing and upcoming projects in this area.

Sri Niroj Kumar Sarkar, GSI was of the opinion that the estimation of peak ground velocity, acceleration and displacement vectors using strong motion network in the influence area of various project sites may be attempted utilizing the existing network and wherever required through augmentation of the same. The comprehensive database obtained after the Nepal Earthquake may also be utilised to understand the efficacy of the attenuation relations for estimation of ground motion parameters.

Dr. P. K. Champati Ray, Indian Institute of Remote Sensing (IIRS) has mentioned that we should have a re-look into what kind of instrumentation has been provided; and how and where to locate the instrument along the fault. He was also of the opinion that Instrumentation has to be strengthened in all important dams, particularly in Himalaya region and consider for improvement of instrumentation (displacement, velocity and acceleration instruments as well as GPS observations) at these dams and all upcoming dams.

Chairman, Central Water Commission was of the view that the third party management of the instrumentation and data gathering may be explored under central Scheme. Sh. Pradeep Kumar, Commissioner (SPR), MoWR, RD & GR suggested that the strengthening/placement work of instrumentation in the major dams may be taken up on priority particularly dams in Himalayan region. The

financial provision may be kept under ongoing Dam Rehabilitation Improvement Programme (DRIP) funded by World Bank or other central scheme. On a query from Dr. Pillai, CWC, concerning possibility of third party management of seismic instruments by NGRI, Sh. D. Srinagesh, informed that they are already associated with several dam projects of Andhra Pradesh and other States as well.

After detailed deliberation, the Committee Members were of the opinion that Instrumentation has to be strengthened in all important dams, particularly in Himalaya region (Seismic Zone IV and Seismic Zone V) and under ongoing Dam Rehabilitation and Improvement Project (DRIP), improvement of instrumentation (displacement, velocity and acceleration instruments as well as GPS observations) at all major DRIP dams may be considered.

29.2.3 Development of a ready reckoner for deciding the radius of high impact zone of the seismic influence – correlating with magnitude and depth of seismic event

Sh. Baidya, IMD informed the Committee that detailed subsurface information, transfer function and other parameter of the dam site as well as detail of the faulting process during an earthquake etc., will be required to get the impact of an earthquake at the dam site. However, he further mentioned that using a simple general attenuation relation, a map of expected intensity considering the hypocentral parameters of an event can be generated, using a script based on MATLAB tool, to get the area of various intensity zones around the event. This map can be used as a ready reckoner to get an idea about the different impact zone of the seismic influence. Center for seismology, IMD/MoES can provide such script that needs MATLAB tool to generate such expected intensity map.

Mr. Srinagesh, NGRI mentioned that IMD should be approached for the intensity shake map for earthquake magnitudes greater than 6.5. This will help in deciding the severity of ground shaking. Further, super imposition of the dam sites on this map shall allow to evaluate the risk involved to the dams. Dr. M L Sharma, IIT Roorkee was also of the opinion that shake map may be used for the purpose. He mentioned that the probabilistic seismic hazard assessment is most of the time incapable of capturing the maximum potential due to lack of data and its treatment for its completeness in time and space, homoginisation and fitting of various earthquake

models for occurrence. Such impact zone can only be estimated deterministically in the Himalayas.

Concluding the discussion, the Committee recommended that IMD may be approached to provide intensity shake map for earthquake of high magnitude which can be used as a ready reckoner to get an idea about the different impact zone under seismic influence.

29.2.4 Needs of modification in prevalent design practices (and also recommendation procedures) with regards to safety of ancillary structures and components – especially at the top and other overhanging portions of the dam – that are prone to significant damages by catastrophic earthquakes.

29.2.5 Ways of defining acceptable damages in dams caused by major earthquake and after-shocks, with linkage to necessities of emergent lowering of reservoir levels.

29.2.6 Possibility of preparing Guidelines for mandatory retrofitting of dams subjected to nominal damages caused by major earthquake.

The Agenda item under 29.2.4, 29.2.5 and 29.2.6 above were discussed in detail and it was opined by the Committee Members that Central Water Commission may consider recommending the formation of separate Committee(s) involving its design experts and also pertinent experts from other Organisations. This will be taken up for further discussion by NCSDP in its next meeting based on the information furnished by States on dams.

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The meeting ended with vote of thanks to the chair.

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Central Dam Safety Organisation

National Committee on Seismic Design Parameters (NCSDP)

29th Meeting (extraordinary)

Summary of the Decisions Taken at the Meeting

Date of Meeting:	19.05.2015	Time:	11:00 h to 16:00 h	Venue :	Conference Room, 525(N), Sewa Bhawan, R K Puram, New Delhi-66
Present Chairperson:	Sh. C K Agrawal, Member (D&R), CWC			Member Secretary:	Sh O P Gupta Director (FE&SA), CWC
Other Members and special Invitees, (Name, Designation, Organization): A List of participants is placed at ***Annexure-I***					

S.N.	Agenda Points / Decision	Responsibility	Achievement/ Progress	Remarks
29.1	General	-	-	-
29.2	Agenda items for discussion			
29.2.1	Understanding the causes, features and effects of Nepal earthquake and subsequent aftershocks	Informative	Discussed and noted	
29.2.2	Necessity of any proactive action plan or reprioritization of plans in light of Nepal earthquake	Concerned project authorities	Recommendation to consider improvement of seismic instrumentation in all major DRIP dams	
29.2.3	Development of a ready reckoner for deciding the radius of high impact zone of the seismic influence – correlating with magnitude and depth of seismic event	IMD	Intensity shake map from IMD	
29.2.4	Needs of modification in prevalent design practices (and also recommendation procedures) with regards to safety of ancillary structures and components – especially at the top and other overhanging portions of the dam – that are prone to significant damages by catastrophic earthquakes.	-	These points will be taken up for further discussion by NCSDP in its next meeting	
29.2.5	Ways of defining acceptable damages in dams caused by major earthquake and after-shocks, with linkage to necessities of emergent lowering of reservoir levels.			
29.2.6	Possibility of preparing Guidelines for mandatory retrofitting of dams subjected to nominal damages caused by major earthquake.			

Annexure –I

29th Meeting (Extraordinary) of National Committee on Seismic Design Parameters (NCSDP) on River Valley Projects

Date: 19.05.2015
Attendance

Sl.No	Name & Address	Designation	Deptt./ Org.	Status/ Representative
I. Committee Members				
1.	Sh C. K. Agrawal	Member (D&R)	CWC, New Delhi	Chairman, NCSDP
2.	Sh. A.B. Pandya	Chairman	CWC, New Delhi	Special Invitee
3.	Sh. Pradeep Kumar	Commissioner (SPR)	MoWR, New Delhi	Member
4.	Sh. L.A.V. Nathan	Chief Engineer (DSO)	CWC, New Delhi	Member
5.	Dr. M.L. Sharma	Professor & Head Deptt. of Earthquake Engg.	DEQ, IIT Roorkee,	Member
6.	Dr. P.K. Champati Ray	Group Head, Geo Science and Disaster management studies	Indian remote sensing (IIRS), Dehradun	Member
7.	Sh. D. Srinagesh	Head, Seismology Observatory, Chief Scientist	NGRI	Representative of NGRI
8.	Sh. P.R. Baidya	Scientist 'E', Centre for Seismology	IMD Delhi	Representative of IMD
9.	Sh. Niroj Kumar Sarkar	Superintending Geologist	GSI, Shillong	Representative of GSI
10.	Sh S. B. Sharma	Director, Geodetic & Research branch,	Survey of India, Dehradun	Representative of Survey of India
11.	Sh. O.P. Gupta	Director, FE&SA	CWC, New Delhi	Member-Secy. NCSDP
II. Other officials and Invitees				
12.	Sh. Y.K. Handa	Chief Engineer, Designs (NW&S)	CWC, New Delhi	CWC, New Delhi
13.	Sh. S.K. Sibal	Chief Engineer, UGBO Lucknow	CWC, Lucknow	CWC, Lucknow
14.	Dr. B.R.K. Pillai	Director (DSR)	CWC, New Delhi	CWC, New Delhi
15.	Sh. L. K. Taneja	Director (DSM)	CWC, New Delhi	CWC, New Delhi
16.	Sh. J.S. Mehta	Director	GSI, New Delhi	GSI, New Delhi
17.	Sh. Ashwini Kumar Shukla	Director Emb (NW&S)	CWC, New Delhi	CWC, New Delhi
18.	Sh. Shahid Hussain	Asst. Director II (DSM)	CWC	CWC, New Delhi
19.	Sh. G. Sanjeeva Reddy	Asst. Director II	CWC	NCSDP Secretariat
20.	Sh. C.L. Premi	Head D'man	CWC	"
21.	Mrs Vinod Sharma	Sr. D'man	CWC	"