Minutes of the 23rd Meeting of National Committee on Seismic Design Parameters (NCSDP) for River Valley Projects held on 20th November, 2012 in CWC, New Delhi

General:

The 23rd meeting of the National Committee on Seismic Design Parameters (NCSDP) for River Valley Projects was held on 20th November 2012 at 10:30 hrs in the Conference Room, Central Water Commission, New Delhi. Sh. A.B. Pandya, Member (D&R), CWC and Chairman, NCSDP chaired the meeting. The list of Members, project representatives and invitees who attended the meeting is given at **Annexure I**.

Meeting commenced with Sh. A.B. Pandya, Chairman, NCSDP welcoming the participants and invitees of the meeting. Highlighting the importance of the NCSDP especially in dealing with the policy related issues of dam safety, Chairman stressed the need for holding NCSDP meetings more regularly. This was followed by a brief introduction of the participants. Thereafter, Member Secretary, NCSDP was requested to take up the agenda items for discussion.

23.1 Confirmation of the minutes of the last meeting

Member Secretary informed that the Minutes of the 22nd meeting of NCSDP held on 24th September, 2010 were circulated to the Members of the Committee; and no observation/ comment on the circulated Minutes have been received by the Secretariat. He also informed that relevant extracts from the Minutes of Meeting were also sent to the concerned project authorities for information/compliance.

The Committee confirmed the minutes of the 22nd meeting as circulated.

23.2 Agenda items carried over from previous meetings.

23.2.1 Guidelines for Site Specific Seismic Studies for river Valley projects

The Member-Secretary apprised the Committee that the observations/suggestions as received from the Members of the Committee were suitably incorporated in the draft document on *"Guidelines for preparation and submission of Site Specific Seismic Study Report of River Valley Project to National Committee on Seismic Design Parameters"* and the same was approved by the Chairman, NCSDP. The copy of the approved document was circulated amongst the Members of the Committee vide letter no. 2/2/2010/FE&SA/ 68-77 dated 10.01.2012, and also uploaded on CWC official website (http://www.cwc.gov.in). ***Committee agreed with Member Secretary's suggestion that the guidelines shall be amended from time to time incorporating the updated decisions of the Committee. Committee also agreed to a suggestion from the Chairman to provide a glossary of technical terms as annexure to the guidelines.***

23.2.2 Approval/clearance of pending projects considered in 22nd NCSDP Meetings

The Member-Secretary apprised the Committee that out of 20 projects discussed in the 22nd meeting of the NCSDP (24.09.2010), approval of 15 projects were communicated vide secretariat letter no. 2/2/2011 (Vol-II)/FE&SA/726-737 dated 22.12.2011 after receipts of the desired information. As suggested by the Member Secretary, the Committee agreed for the inclusion of the summary of approved parameters of these 15 projects in the minutes of the meeting (**Annexure-II)** for record purpose.

The Member Secretary further informed that out of remaining five projects, compliance has been received from four projects while no response has been received in case of Pench Valley Group Water Supply Scheme, Madhya Pradesh. Accordingly, Committee held discussion for the balance four projects as under:

1. Halon Project, Madhya Pradesh

No representative of the project authority was present in the meeting. However, in the meeting it was pointed out that the compliance report received from project authorities indicates seismic co-efficients (α_h and α_v) for the earthen dam only and not for the concrete/masonry spillway portion. ***Accordingly, it was decided by the Committee to request the project authorities for submission of the seismic design coefficients for concrete/masonry spillway portion at the earliest***.

2. Demwe Lower H.E. Project, Arunachal Pradesh

A presentation on the study report was made by the project authorities. During discussion, the Committee agreed with the Member Secretary's suggestion to round off α_h and α_v values up to two decimal places in line with Committee's earlier decision (20th meeting held on 23.09.2008).

After brief deliberation, the Committee accorded approval to study report. The summarized seismic design parameters of the approved report are as under:

<table>
<tr><td colspan="3">Maximum Credible Earthquake Magnitude</td><td>8.0</td><td colspan="2">Distance to zone of energy release (km)</td><td>14</td><td>Focal depth (km)</td><td>15</td></tr>
<tr><td rowspan="2">PGA (h)</td><td>MCE</td><td colspan="2">0.38 g</td><td rowspan="2">PGA (v)</td><td>MCE</td><td colspan="3" rowspan="2">2/3rd of the corresponding horizontal values</td></tr>
<tr><td>DBE</td><td colspan="2">0.19g</td><td>DBE</td></tr>
<tr><td colspan="4">Horizontal seismic co-efficient (α_h)</td><td>0.28</td><td colspan="3">Vertical seismic co-efficient (α_v)</td><td>0.18</td></tr>
<tr><td colspan="2">Study Report Reference</td><td colspan="7">IIT Roorkee's Report No. EQD-3003/2008-2009 (Oct.-2008) with additional information.</td></tr>
</table>

Dr A. S. Arya observed that a sudden change indicated in the profile of the dam at neck portion may call for careful design, and accordingly the Committee requested the project authorities to take note of above observation.

3. Rupsiabagar Khasiabara H.E. Project, Uttarakhand

Since no representative of the project authority was present in the meeting, the project was not considered for discussion.

4. Bowala Nand Prayag, H.E. Project, Uttarakhand

Copy of the revised study was circulated amongst the Members during the meeting and a presentation on the study report was also made by the project authorities.

Chairman observed that safety criteria used for barrage design should be explicitly narrated in the study report. He also wanted to know if steps for arriving αh and α_v values have been enumerated in the guidelines. Dr. M.L. Sharma, DEQ, IIT, Roorkee pointed out that such details shall form the part of BIS, which is yet to be finalized. Dr. Arya was of the view that CWC should take a lead role in the concerned BIS Committee for early finalization of the code.

During the meeting the Committee felt that the values of seismic design co-efficients arrived for the 12 m high barrage are on higher side. ***After brief deliberation, the Committee approved the study report incorporating the revised seismic co-efficients suggested by representative of IIT Roorkee (as Consultant) and confirmed in writing vide Project authorities letter dated 23.11.2012 given as Annexure-III. The summarized seismic design parameters of the approved report are as under:***

<table>
<tr><td colspan="3">Maximum Credible Earthquake Magnitude</td><td>8.0</td><td colspan="2">Distance to zone of energy release (km)</td><td>15</td><td>Focal depth (km)</td><td>15</td></tr>
<tr><td rowspan="2">PGA (h)</td><td>MCE</td><td colspan="3">0.36 g</td><td rowspan="2">PGA (v)</td><td>MCE</td><td colspan="2" rowspan="2">2/3rd of the corresponding horizontal values</td></tr>
<tr><td>DBE</td><td colspan="3">0.18g</td><td>DBE</td></tr>
<tr><td colspan="4">Horizontal seismic co-efficient (α_h)</td><td>0.18</td><td colspan="3">Vertical seismic co-efficient (α_v)</td><td>0.12</td></tr>
<tr><td colspan="3">Study Report Reference</td><td colspan="6">IIT Roorkee's Report No. EQD-3030/09-10 (Oct -2009) with additional information vide letter dated 23.11.2012.</td></tr>
</table>

23.3 New projects considered for approval of the Committee.

23.3.1 Par-Tapi –Narmada Link project, Gujarat & Maharashtra.

A presentation on the study report involving seven dams of the above link project was made by the project authorities. The Committee noted that α_h and α_v values have been presented in terms of 'g' which should not be the case as these are dimensionless co-efficients.

Member-Secretary pointed out that for earthen dam of such high heights (up to 76m) the duration of strong shaking should be explicitly highlighted in the report. This was agreed by the consultant and subsequently conveyed in writing vide their email dated 18.12.2012 given as **Annexure-IV**.

After brief deliberation, the Committee accorded approval to study report of the Par-Tapi-Narmada Link Project. The summarized seismic design parameters of the approved report in respect of seven dams of above Link project are as under:

Jheri Dam, Maharashtra

Maximum Credible Earthquake Magnitude		6.3		Epicentral distance (km)		20.1		Focal depth (km)	10
PGA (h) (Cluster-1)	MCE	0.17g			PGA (v) (Cluster-1)	MCE	0.15g		
	DBE	0.09g				DBE	0.08g		
Horizontal seismic co-efficient (α_h)		Concrete	0.09		Vertical seismic co-efficient (α_v)		Concrete		0.09
		Earthen	0.02				Earthen		0.01

(ii) Mohankavchali Dam, Gujarat

Maximum Credible Earthquake Magnitude		6.3		Epicentral distance (km)		20.1		Focal depth (km)	10
PGA (h) (Cluster-1)	MCE	0.17g			PGA (v) (Cluster-1)	MCE	0.15g		
	DBE	0.09g				DBE	0.08g		
Horizontal seismic co-efficient (αh)		Concrete	0.09		Vertical seismic co-efficient (αv)		Concrete		0.09
		Earthen	0.02				Earthen		0.01

(iii) Paikhed Dam, Gujarat

Maximum Credible Earthquake Magnitude		6.3		Epicentral distance (km)		20.1		Focal depth (km)	10
PGA (h) (Cluster-1)	MCE	0.17g			PGA (v) (Cluster-1)	MCE	0.15g		
	DBE	0.09g				DBE	0.08g		
Horizontal seismic co-efficient (α_h)		Concrete	0.09		Vertical seismic co-efficient (α_v)		Concrete		0.08
		Earthen	0.02				Earthen		0.02

(iv) Chasmandava Dam, Gujarat

Maximum Credible Earthquake Magnitude		5.8		Epicentral distance (km)		25		Focal depth (km)	10
PGA (h) (Cluster-2)	MCE	0.17g			PGA (v) (Cluster-2)	MCE	0.14g		
	DBE	0.08g				DBE	0.07g		
Horizontal seismic co-efficient (α_h)		Concrete	0.09		Vertical seismic co-efficient (α_v)		Concrete		0.08
		Earthen	0.03				Earthen		0.02

(v) Chikkar Dam, Gujarat

Maximum Credible Earthquake Magnitude		5.8		Epicentral distance (km)		25		Focal depth (km)	10
PGA (h) (Cluster-3)	MCE	0.17g			PGA (v) (Cluster-3)	MCE	0.139g		
	DBE	0.08g				DBE	0.067g		
Horizontal seismic co-efficient (α_h)		Concrete	0.08		Vertical seismic co-efficient (α_v)		Concrete		0.08
		Earthen	0.02				Earthen		0.02

(vi) Dabdar Dam, Gujarat

Maximum Credible Earthquake Magnitude		5.8	Epicentral distance (km)		25	Focal depth (km)	10
PGA (h) (Cluster-3)	MCE	0.17g		PGA (v) (Cluster-3)	MCE	0.14g	
	DBE	0.08g			DBE	0.07g	
Horizontal seismic co-efficient (α_h)		Concrete	0.10	Vertical seismic co-efficient (α_v)		Concrete	0.09
		Earthen	0.03			Earthen	0.02

(vii) Kelwan Dam, Gujarat

Maximum Credible Earthquake Magnitude		5.8	Epicentral distance (km)		25	Focal depth (km)	10
PGA (h)	MCE	0.17g		PGA (v)	MCE	0.14g	
	DBE	0.08g			DBE	0.07g	
Horizontal seismic co-efficient (α_h)		Concrete	0.10	Vertical seismic co-efficient (α_v)		Concrete	0 .09
		Earthen	0.03			Earthen	0.02

(Cluster-1)	Total duration of shaking (second)	43.3	(Cluster-2 &3)	Total duration of shaking (second)	41.98
	Duration of strong shaking (second)	8.5		Duration of strong shaking (second)	7.3
Study Report of link project Reference	CWPRS Technical Report No. 4848 (June, 2011- revised June, 2012)				
	Note: *The dam sites have been divided into three Clusters (Cluster-1 to Cluster-3) by the consultant keeping in view of the large differences in the distances of the dam sites from the major tectonic features governing the seismic hazard in the vicinity of the sites.*				

23.3.2 Damanganga – Pinjal Link project, Gujarat & Maharashtra.

A presentation on the study report involving two dams of the above link project was made by the project authorities.

Member-Secretary pointed out that for earthen dam of such high heights (up to 75.62m) the duration of strong shaking should be explicitly highlighted in the report. This was agreed by the consultant and subsequently conveyed in writing vide their email dated 18.12.2012 given as **Annexure-IV**.

After brief deliberation, the Committee accorded approval to study report of Damaganga-Pinjal Link Project. The summarized seismic design parameters of the approved report in respect of two dams of the above link project are as under:

(i) Bhugad dam, Gujarat & Maharashtra

Maximum Credible Earthquake Magnitude		6.3	Epicentral distance (km)		18	Focal depth (km)	10
PGA (h)	MCE	0.18g		PGA (v)	MCE	0.16g	
	DBE	0.08g			DBE	0.07g	
Horizontal seismic co-efficient (α_h)		Concrete	0.09	Vertical seismic co-efficient (α_v)		Concrete	0.09
		Earthen	0.02			Earthen	0.02

(ii) Khargihill dam, Maharashtra

Maximum Credible Earthquake Magnitude		6.3	Epicentral distance (km)		18	Focal depth (km)	10
PGA (h)	MCE	0.18g		PGA (v)	MCE	0.16g	
	DBE	0.08			DBE	0.07g	
Horizontal seismic co-efficient (α_h)		Concrete	0.18	Vertical seismic co-efficient (α_v)		Concrete	0.17
		Earthen	0.04			Earthen	0.03

Total duration of shaking (second)	42.84	Duration of strong shaking (second)	8.3
Study Report of link project Reference	CWPRS Technical Report No. 4847 (June, 2011- revised June, 2012)		

23.3.3 Tato-II H.E. Project, Arunachal Pradesh

A presentation on the study report was made by the project authorities. On a specific query by a Member, project authorities informed that they are in the process of taking up the MEQ studies by an expert agency, and the study will be submitted latest by December, 2013.

GSI representative was of the view that specific reference of seismotectonic atlas (SEISAT No) should be given for easy correlation of tectonic feature and its continuity and the same was agreed by the Committee. Sh. Niroj Kumar Sarkar, representative of GSI, was of the view that the choice of the appropriate Attenuation Relationship should be justified in relation to the geological set up. In response, Dr. M.L. Sharma, DEQ, IIT, Roorkee and Dr. I.D. Gupta, CWPRS were of the view that some of the justification is already given in the guidelines, and further elaboration may be a difficult task.

After brief deliberation, the Committee accorded approval to the study report subject to the condition that the MEQ study report will be submitted by project authorities latest by December, 2013. The summarized seismic design parameters of the approved report are as under:

Maximum Credible Earthquake Magnitude		7.5	Epicentral distance (km)		5	Focal depth (km)	15
PGA (h)	MCE	0.44 g		PGA (v)	MCE	0.36g	
	DBE	0.21g			DBE	0.17g	
Horizontal seismic co-efficient (α_h)			0.26	Vertical seismic co-efficient (α_v)			0.21
Study Report Reference	IIT Roorkee's Report No. EQD-3004/12-13(May-2012)						

23.3.4 Lower ORR Dam, Madhya Pradesh

A presentation on the study report was made by the project authorities. The Committee noted that earlier observations of GSI were also applicable in most of the other projects brought before the Committee. As desired by the Committee, the Consultant agreed to furnish the duration of strong shaking and this was complied vide their email dated 18.12.2012 given as **Annexure- IV.**

After brief deliberation, the Committee accorded approval to study report. The summarized seismic design parameters of the approved report are as under:

<table>
<tr><td colspan="2">Maximum Credible Earthquake Magnitude</td><td>6.0</td><td colspan="2">Epicentral distance (km)</td><td>24.7</td><td colspan="2">Focal depth (km)</td><td>15</td></tr>
<tr><td rowspan="2">PGA (h)</td><td>MCE</td><td colspan="3">0.11g</td><td rowspan="2">PGA (v)</td><td>MCE</td><td colspan="2">0.09g</td></tr>
<tr><td>DBE</td><td colspan="3">0.05g</td><td>DBE</td><td colspan="2">0.04g</td></tr>
<tr><td colspan="2" rowspan="2">Horizontal seismic co-efficient (α_h)</td><td colspan="2">Lower Orr Dam (Earthen)</td><td>0.03</td><td colspan="2" rowspan="2">Vertical seismic co-efficient (α_v)</td><td>Lower Orr Dam (Earthen)</td><td>0.02</td></tr>
<tr><td colspan="2">Spillway Section</td><td>0.06</td><td>Spillway Section</td><td>0.05</td></tr>
<tr><td colspan="3">Total duration of shaking (second)</td><td colspan="3">44.42</td><td colspan="2">Duration of strong shaking (second)</td><td>8.9</td></tr>
<tr><td colspan="3">Study Report Reference</td><td colspan="7">CWPRS Technical Report No. 4945, April 2012</td></tr>
</table>

23.3.5 Dikhu H.E. Project, Nagaland

A presentation on the study report was made by the project authorities. It was noted by the Committee that the Micro earthquake (MEQ) studies have not been carried out by the project authorities for the dam of 112 m height located in seismic zone V.

In response to query from Member Secretary about the PGA values coming same for horizontal and vertical component, the representative of IIT, Roorkee clarified that this was owing to the short range effect. It was also desired by the Committee that duration of strong shaking should be explicitly highlighted in the report.

Sh. Niroj Kumar Sarkar, pointed out that only one geological section has been furnished and no specific reference is made about geotechnical properties of the rock mass in the area of interest. He reiterated that specific reference of seism-tectonic atlas (SEISAT No) should also be given. Dr. Shovan Lal Chattoraj, representative from IIRS was of the view that document is poor in compilation owing to typographical errors and cut and paste contents from DPR.
Further, Committee was unanimous in its view that the seismic design co-efficients are considerably on the lower side.

After detailed discussion, the Committee decided that the study needed to be revised in light of above observations.

23.3.6 Dagmara H.E. Project, Bihar

A presentation on the study report was made by the project authorities. As discussed by the Committee, the project authorities agreed to furnish duration of shaking and seismic co-efficients for earthen dam portion and this was complied vide consultant's e-mail dated 18.12.2012 and letter dated 19.12.2012 given as **Annexure- IV** and **Annexure-V** respectively**.**

After brief deliberation, the Committee accorded approval to study report. The summarized seismic design parameters of the approved report are as under:

<table>
<tr><td colspan="3">Maximum Credible Earthquake Magnitude</td><td>8.5</td><td colspan="2">Epicentral distance (km)</td><td>0</td><td>Focal depth (km)</td><td>50</td></tr>
<tr><td rowspan="2">PGA (h)</td><td>MCE</td><td colspan="3">0.39g</td><td rowspan="2">PGA (v)</td><td>MCE</td><td colspan="2">0.25g</td></tr>
<tr><td>DBE</td><td colspan="3">0.20g</td><td>DBE</td><td colspan="2">0.12g</td></tr>
<tr><td colspan="2" rowspan="2">Horizontal seismic co-efficient (α_h)</td><td>Concrete portion</td><td>0 .11</td><td colspan="2" rowspan="2">Vertical seismic co-efficient (α_v)</td><td>Concrete portion</td><td colspan="2">0.07</td></tr>
<tr><td>Earthen dam</td><td>0.16</td><td>Earthen dam</td><td colspan="2">0.11</td></tr>
<tr><td colspan="3">Total duration of shaking (second)</td><td>40.58</td><td colspan="2">Duration of strong shaking (second)</td><td colspan="3">9.2</td></tr>
<tr><td colspan="3">Study Report Reference</td><td colspan="6">CWPRS Technical Report No. 4957 (June-2012)</td></tr>
</table>

23.3.6 Review of the site specific seismic design parameters of Rampur HEP, Himachal Pradesh

Member-Secretary informed the Committee that the revision of the earlier approved seismic design parameters has been requested by the project authorities because of the fact that Rampur HEP does not involve construction of any dam structure, and the parameters are needed only for the design of powerhouse structure.

After brief deliberation, the Committee accorded approval to the study report as per below summarized seismic design parameters for the powerhouse structure:

<table>
<tr><td colspan="3">Maximum Credible Earthquake Magnitude</td><td>7.5</td><td colspan="2">Distance to zone of energy release(km)</td><td>15</td><td>Focal depth (km)</td><td>15</td></tr>
<tr><td rowspan="2">PGA (h)</td><td>MCE</td><td colspan="3">0.31g</td><td rowspan="2">PGA (v)</td><td>MCE</td><td colspan="2" rowspan="2">2/3rd of corresponding horizontal values</td></tr>
<tr><td>DBE</td><td colspan="3">0.16g</td><td>DBE</td></tr>
<tr><td colspan="3">Horizontal seismic co-efficient (α_h)</td><td colspan="2">0.14</td><td colspan="2">Vertical seismic co-efficient (α_v)</td><td colspan="2">0.09</td></tr>
<tr><td colspan="3">Study Report Reference</td><td colspan="6">IIT Roorkee's Report No. EQD-3018-EQD:2009-26(M), September 2009 with additional information</td></tr>
</table>

23.4 Additional Agenda items with the permission to the chair

23.4.1 Tiuni-Plasu H.E. Project, Uttarakhand

A presentation on the study report was made by the project authorities.

After deliberation, the Committee accorded approval to study report as per below summarized seismic design parameters:

Maximum Credible Earthquake Magnitude		8.0	Epicentral distance (km)		24	Focal depth (km)	15
PGA (h)	MCE	0.47 g		PGA (v)	MCE	0.35g	
	DBE	0.27g			DBE	0.20g	
Horizontal seismic co-efficient (α_h)		0.27	Vertical seismic co-efficient (α_v)			0.20	
Study Report Reference		IIT Roorkee's Report No. EQD-3005/11-12 (June -2012)					

23.4.2 Composition and Terms of Reference (TOR) of NCSDP- Need for review

Member Secretary gave a brief background of the brief history of the NCSDP and its present composition as well as the Term of Reference, He requested the Committee to deliberate on the necessity of the further changes, if any, in light of the present understanding of the subject and its impact in terms of dam safety.

Committee Members were in agreement that the national scenario regarding the approach to the understanding of the earthquake phenomenon and its influence on structure have undergone considerable change over the decades. They felt the need for enhancement in composition of the Committee as well as its mandate to look into varied aspects of earthquake parameters related to river valley projects in a more comprehensive and detailed manner.

After brief discussion, it was agreed that Members of the Committee will forward their written suggestions/recommendations in this regard to the Secretariat for further deliberation.

23.4.3 Uploading the list of projects with seismic design parameters approved by NCSDP to CWC official website.

Member Secretary proposed to upload on the CWC's website seismic design parameters of river valley projects approved by NCSDP from 1991 onwards; and accordingly the draft of the tabulated information was placed before the Committee for approval. Committee agreed to the suggestion from a Member to remove the name of the consultant from the table. It was also discussed by the Committee whether longitude/latitude of the projects could be mentioned in the table. Sh. Upendra Nath Mishra, Survey of India has mentioned that there is no problem in giving the longitude/latitude values without giving the grid number. The Members of the Committee were in agreement with the view that table may be included in the guidelines document as an annexure instead uploading in the website separately.

Accordingly, the Committee decided that the said annexure of the guidelines shall be updated from time to time to reflect the approved seismic design parameters of river valley projects.

The updated document on " Guidelines for Preparation and Submission of Site Specific Seismic Study Report of River Valley Project to National Committee on Seismic design Parameters" thus finalized by the Committee is given as Annexure- VI.

The meeting ended with vote of thanks to the chair.

Summary of Policy related decisions of 23rd NCSDP meeting:

1 α_h and α_v values shall be round off up to two decimal places in line with Committee's earlier decision (20th meeting held on 23.09.2008). (Item no. 23.2.2 para 2)

2 α_h and α_v values should not be presented in terms of 'g' as these are dimensionless co-efficients. (Item no. 23.3.1)

3 Specific reference of seismotectonic atlas (SEISAT No) should be given for easy correlation of tectonic feature and its continuity. (Item no. 23.3.1)

4 Guidelines shall be updated from time to time to reflect the approved seismic design parameters of river valley projects. (Item no. 23.4.3)

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Annexure –I

23rd Meeting of National Committee on Seismic Design Parameters (NCSDP) on River Valley Projects

Date : 20.11.2012
Attendance

Sl.No.	Name & Address	Designation	Deptt./ Org.	Status/ Representative
I. Committee Members				
1.	Sh. A.B.Pandya	Member (D&R)	CWC, New Delhi	Chairman, NCSDP
2.	Sh. L.A.V. Nathan	Chief Engineer (DSO)	CWC, New Delhi	Member
3.	Dr. A.S. Arya	Ex Pro Vice Chancellor	University of Roorkee	Non Official Member
4.	Sh. Niroj Kumar Sarkar	Superintending Geologist	GSI, Shillong	Representative of GSI
5.	Dr. M.L. Sharma	Professor & Head Deptt. of Earthquake Engg.	DEQ, IIT Roorkee,	Member
6.	Sh. P.R. Baidya	Scientist 'E'	IMD Delhi	Representative of IMD
7.	Sh. Upendra Nath Mishra	Director, Geodetic & Research branch	Survey of India	Representative of Survey of India
8.	Dr. I. D. Gupta	Director	CWPRS, Pune	Member
9.	Dr. Shovan Lal Chattoraj	Scientist, Geo Science Division	Indian remote sensing (IIRS), Dehradun	Representative of IIRS
10.	Dr. B. R. K. Pillai	Director, FE&SA	CWC, New Delhi	Member-Secy. NCSDP
II. Special Invitees and other officials				
11.	Dr. Manish Srikhande	Assoc. Professor	DEQ, IIT Roorkee	IIT Roorkee
12.	Sh. O.P. Gupta	Deputy Director	CWC	NCSDP Secretariat
13.	Sh. Saurabh	Asst. Director	CWC	''
14.	Sh. G. Sanjeeva Reddy	Asst. Director II	CWC	"
15.	Sh. C.L. Premi	Head Draftsman	CWC	"
III. Project Representatives and Consultants				
16.	Sh. R.K.Jain	Chief Engineer	NWDA	Par- Tapi Narmada Link project, Gujarat& Maharashtra
17.	Sh. O.P.S. Kushwah	Superintending Engineer	NWDA	-Do-
18.	Sh. N.C.Jain	Superintending Engineer	NWDA	-Do-
19.	Sh. D.K.Sharma	Executive Engineer	NWDA	-Do-
20.	Sh. Naveen Alagh	Sr. Vice President	THPP Ltd. Noida	Tato-II H.E. Project, Arunachal Pradesh
21.	Sh. Deepak	Sr. Vice President	THPPL. Noida	Tato-II H.E.Project, Arunachal Pradesh
22.	Sh.Vinay Mishra	Sr. Vice President	-Do-	-Do-
23.	Sh.Bhupendra	Sr. Vice President	-Do-	-Do-

24.	Sh.Tapan Mukopadhyay	Sr. Vice President	-Do-	-Do-
25.	Sh. TSK Singh	Sr. Vice President	-Do-	-Do-
26.	Bhupendra Singh Parihar		-Do-	-Do-
27.	Sh. R.K.Jain	Chief Engineer	NWDA	Damanganga- Pinjal Link Project, Gujarat&Maharashtra
28.	Sh. O.P.S.Kushwah	Supt. Engineer	NWDA	-Do-
29.	Sh. N.C.Jain	Supt. Engineer	NWDA	-Do-
30.	Sh. D.K.Sharma	Executive Engineer	NWDA	-Do-
31.	Sh. Rama Rao	MD	MESP Ltd. Noida	Dukhu H.E. Project, Nagaland
32.	Sh. Rakesh Mathur	Engineer	-Do-	-Do-
33.	Sh. Siva Koti	Engineer	-Do-	-Do-
34.	Sh. Yogendra Deva	Engineer	-Do-	-Do-
35.	Sh. S.K.Garg	Engineer	-Do-	-Do-
36.	Ms.Mugdha Patwardhan	Engineer	-Do-	-Do-
37.	Sh. R.K.Jain	Chief Engineer	NWDA	Lower Orr Dam, Madhya Pradesh
38.	Sh. O.P.S.Kushwah	Supt. Engineer	NWDA	-Do-
39.	Sh. N.C.Jain	Supt. Engineer	NWDA	-Do-
40.	Sh. D.K.Sharma	Executive Engineer	NWDA	-Do-
41.	Sh. A.K.Pandey	Managing Director	BHPC, Patna	Dagmara HE Project, Bihar
42.	Sh.M.M.Verma	Sr. GM (commercial, WAPCOS	WAPCOS	-Do-
43.	M.V.Gani	Advisor	BHPC, Patna	-Do-
45.	Sh. A.K.Gahlot	Chief (Civil) & Head (MH&AS)	WAPCOS	-Do-
46.	Sh. P.K. Kundu		WAPCOS	-Do-
47.	Sh. R.S. Chauhan	Consultant,	SJVNL	Rampur HEP, Himachal Pradesh
48.	Sh. Sanjeev Gupta	Sr.Manager	SJVNL	Rampur HEP, Himachal Pradesh
49.	Sh. Gagan Agrawal	Sr.Vice President	Athena Demwe Power Ltd.	Demwe Lower HEP, Arunachal Pradesh
50.	Dr. S. S. Gahia	Sr.Vice President		-Do-
51.	Sh. Tarun Sawaroji	Chief Analysist		-Do-
52	Sh. Aravind Kumar	General Manager	UJVN Ltd, Dehradun	Bowla Nand Prayag HEP, Uttarakhand
53.	Sh. Charu Kohoni	Asstt. Engineer	-Do-	-Do-
54	Sh Prem Kumar	Asstt. Engineer	-Do-	-Do-
55.	Sh. R.S. Chauhan	Consultant,	SJVNL	Rampur HEP, Himachal Pradesh
56.	Sh. Sanjeev Gupta	Sr. Manager	SJVNL	Rampur HEP, Himachal Pradesh

Annexure –II

Recommended design earthquake parameters in respect of HE. Projects considered in 22nd meeting of NCSDP held on 24.09.2010 at CWC New Delhi

S.No.	Project Name	State	M	PGA (median value)	α_h	α_v
1	Dibang HEP	Arunachal Pradesh	7.5	0.19g	0.282	0.188
2	Lower Siang HEP	Arunachal Pradesh	7.0	0.18g	0.238	0.159
3	Panan HEP	Sikkim	7.5	0.18g	0.276	0.184
4	Rampur HEP	Himachal Pradesh	7.1	0.16g	0.207	0.138
5	Gundia A) Concrete Dam B) Earth Dam	Karnataka	6.3	0.114g	 0.15 0.11	 2/3rd of the α_h
6	Mangdechu HEP	Bhutan	7.7	0.18g	0.354	0.236
7	Phata Byung HEP	Uttarakhand	7.2	0.18g	0.255	0.17
8	Jelam Thamak HEP	Uttarakhand	7.1	0.18g	0.288	0.192
9	Sainj HEP	Himachal Pradesh	7.3	0.16g	0.224	0.149
10	Kutehr HEP	Himachal Pradesh	7.1	0.16g	0.232	0.155
11	Bajoli Holi HEP	Himachal Pradesh	7.2	0.16g	0.213	0.142
12	Nyamjang Chu HEP	Arunachal Pradesh	7.7	0.18g	0.288	0.192
13	Sissri HEP	Arunachal Pradesh	6.6	0.18g	0.27	0.18
14	Hirong HEP	Arunachal Pradesh	7.3	0.18g	0.229	0.153
15	Kiru HEP	Jammu & Kashmir	7.5	0.16g	0.26	0.17

M Estimated value of Design Basis Earthquake (DBE) with 50% probability of exceeding in 100 years on Richter scale

PGA Peak Ground Acceleration (median value)

α_h Horizontal Seismic co-efficient

α_v Vertical Seismic co-efficient

DBE Design Basis Earthquake

Annexure-IV

Information as Supplied by CWPRS Pune (as Consultant) vide their email dated 18.12.2012

Shri O.P.Gupta,
CWC, New Delhi

Sir,

As directed I am giving below the total and strong motion duration of the MCE and DBE levels and both components of acceleration time histories for the four projects from CWPRS, Pune, which had come up for approval in the 23rd meeting of the NCSDP on 20th Nov. 2012.

Lower Orr dam, Madhya Pradesh:

Total duration 44.42 sec
Strong motion duration 8.9 sec

Damanganga-Pinjal link project, NWDA:

Total duration 42.84 sec
Strong motion duration 8.3 sec

Par-Tapi-Narmada link project, NWDA:

Cluster 1

Total duration 43.3 sec
Strong motion duration 8.5 sec

Cluster 2 and 3

Total duration 41.98 sec
Strong motion duration 7.3 sec

Dagmara Project, Bihar:

Total duration 40.58 sec
Strong motion duration 9.2 sec

With Regards,
L.R.Pattanur,
CWPRS Pune