BUREAU OF INDIAN STANDARDS

AGENDA

23rd Meeting of Water Conductor Systems Sectional Committee, WRD 14		
Day and Date	**Time**	**Venue :**
Thursday, 30 May 2024	From 10:30 A.M.	Hybrid For Physical Participation: Manak Bhawan, BIS HQ
Link for virtual participation: https://bismanak.webex.com/bismanak/j.php?MTID=ma2a401dfad13d3eeabc024f8009a4df7		
Chairperson: SHRI VIJAI SARAN, CHIEF ENGINEER, DESIGN (NW&S), CWC		**Member Secretary**: SHRI NAVDEEP YADAV, ASSISTANT DIRECTOR, WRD, BIS

Item 0 WELCOME AND INTRODUCTORY REMARKS

Item 1 CONFIRMATION OF THE MINUTES OF THE LAST MEETING

The 22nd meeting of the WRD 14 Sectional Committee was held on 11th December 2023 and the minutes duly approved by the Chairperson were circulated vide BIS email dated 24th January 2024. No comments have been received. The Committee may CONFIRM the minutes as circulated.

Item 2 COMPOSITION OF THE COMMITTEE

2.1 The present composition and attendance of the last three meetings of the Committee is given in Annex 1.

The Committee may REVIEW.

2.2 Following fresh nominations have been received from the member organization.

S. No.	**Organization**	**Name of the Nominated Member**
1	H.C.C. LTD, MUMBAI	Shri Suryarao Chalamkuri Shri Praveen Shettigar Suryarao (Alternate)

The above nomination is the same as members previously representing the organization in the Committee. The decision on accepting the nomination may be taken in consultation with the members.

The Committee may NOTE.

2.3 The following nomination has been received from non-member organization for co-option. However, nomination from this organization was not invited by the BIS / Sectional Committee.

S. No.	Organization	Name of the Nominated Member
1	DMR Hydro Engineering & Infrastructures Limited	Shri N.K Jain, Senior Vice President & Head Civil Shri Dibyajyoti Sinha, Lead manager Civil (Alternate)

2.4 The composition of the Committee may be reviewed with the inclusion of some more members representing premier organizations including IITs unrepresented in the Committee like IIT Delhi, IIT Mumbai, IIT Chennai, IIT Kharagpur, IIT-BHU Varanasi & IIT Guwahati. In this regard, BIS Secretariat has written letters to the HoD of their Civil Engg Departments requesting for nomination of faculty in the Sectional Committee. The status of their reply will be informed in the meeting.

The Committee may NOTE & DECIDE.

Item 3 TITLE, SCOPE AND PROGRAMME OF WORK OF WRD 14

3.1 The present scope and programme of work under this Committee are given in Annex 2. Member Secretary to apprise the Committee with programme of work.

The Committee may NOTE.

Item 4 DRAFT STANDARD FOR FINALIZATION

4.1 Doc. No. WRD 14(18185) Code of Practice for Design of Tunnels Conveying Water Part 4 Structural Design of Concrete Lining in Rock [First Revision of IS 4880 (Part 4): 1971]

{Earlier Document no. WRD 14(11673)}

The Committee in the last meeting deliberated on the reconciliation of the formulae (Annexure D of the draft) and input received from CSMRS (as placed below), and subsequently decided to establish a working group (WG-1) with the following members to discuss the inputs.

1. Prof. Z Ahmed, IIT Roorkee
2. Geological Survey of India
3. Central Soil & Materials Research Station
4. Central Institute of Mining & Fuel Research.
5. National Hydroelectric Power Corporation.

In this regard, working group meeting of WRD 14/WG-1 was held on 04 March 2024 and the decision taken by the working group on the CSMRS input is placed below.

Page No	Location	REMARKS	Addition/ Modification Suggested	Reply received from CSMRS	The decision of the Working group in the meeting held on 04 March 2024
19	Ø=the angle of repose of the soil	The description of Ø may be checked as in figure 5 the rock load around the cavity may be due to rock.	The word rock may be added. Ø = the angle of repose of the soil / rock	The 'the angle of repose of the soil' may please be replaced with 'friction angle of rock'	May be replaced with 'friction angle of rock mass'.

Further, a working group meeting was convened on April 10, 2024, to discuss the inputs provided by IIT Roorkee on Annex D of the draft. Professor Z. Ahmed informed the working group that he had coordinated with various faculty members of the Structural Engineering & Geotechnical Engineering departments at IIT Roorkee. They reported that they could not find any reference to the equations mentioned in Annex D of the draft. Consequently, he suggested that the inputs from IIT Roorkee be considered as 'NIL.' Additionally, during the meeting, there was a discussion about who could submit inputs on the draft. The working group proposed referring this matter to the Committee for Reconciliation of the formulas in Annex D.

It is submitted before the Committee that the existing WC-draft (Doc No. 18185) has already crossed the BIS time frame of standards preparation and the document still requires further technical deliberations before reaching to a final shape. The Document therefore needs to reviewed at its present stage of Wide Circulation and circulated as a fresh document with new document number.

The Committee may NOTE and DECIDE.

Item 5 DRAFT STANDARDS FOR APPROVAL FOR WIDE CIRCULATION

5.1 Doc. No. WRD 14(19357), IS 9761: 1995 Hydropower intakes – Criteria for Hydraulic Design [Second Revision of IS 9761]

{Earlier Document no. WRD 14(15243) C}

In the last meeting, the Committee deliberated on the draft document further and felt that more discussion is required at the working group level to remove all the ambiguities from the document and also to incorporate provisions related to pumped storage hydropower. The Committee therefore constituted a working group (WG-2) of

the following experts for further discussion on the draft document and submit the revised draft. The Committee also authorized the working group (WRD 14/WG-2) to include any additional expert as deemed suitable.

1. Director HCD, E&NE, CWC (Convenor)
2. Central Water & Power Research Station
3. Prof Z. Ahmad, IIT Roorkee
4. Prof. Nayan Sharma, In personal capacity
5. National Hydroelectric Power Corporation
6. THDC India Ltd
7. SJVN Ltd

The first meeting of the Working Group was held on 18.03.2024, 10.30 AM. The minutes of the meeting as received from Convenor WRD 14/WG-2 have been attached to the agenda and an initial draft document for IS 9761 (second revision) has been circulated with members of the Working Group for their views. After incorporating the same, the draft IS 9761 shall be put before members of the Committee for their views / suggestions.

The existing P-draft (Doc No. 19357) has already crossed the BIS time frame of standards preparation. Committee shall take decision regarding the adoption of new P-draft.

The Committee may NOTE and DECIDE upon the preparation of revised draft document as a fresh.

ITEM 6 COMMENTS ON PUBLISHED STANDARDS

6.1 Criteria for Hydraulic Design of Surge Tanks: Part 1 Simple, Restricted Orifice and Differential Surge Tanks (Second Revision of IS 7396 (Part 1))

6.2 Criteria for Hydraulic Design of Surge Tanks: Part 2 Tail Race Surge Tanks (Second Revision of IS 7396 (Part 2))

In the last meeting, the Committee deliberated on the inputs received from SJVN Limited and NHPC Limited on IS 7396 Part 1. The unresolved comment of SJVNL is placed in Annex 3 where the Committee desired supporting literature for deliberation in the meeting. Further, concerning comments received from NHPC, the Committee felt the organizations conversant with electromechanical components may also be involved for review and requested the Member Secretary to facilitate the participation of CEA in the meeting for effective deliberation on the received inputs on the above standards. In this regard, reminders were sent vide email dated 08 April 2024 & 02 May 2024 to submit their views on the received comments from NHPC. However, inputs are awaited.

The Committee may NOTE & DECIDE.

ITEM 7 DOCUMENTS UNDER REVISION

7.1 Criteria for Structural Design of Penstocks Part 2 Buried / Embedded Penstocks in Rock [First revision of IS 11639 (Part 2): 1995]

In the last meeting, the Committee requested SNC Lavalin to provide a draft document on buried/embedded penstocks in soil by including all their inputs within two months. In this regard, the reminder was sent vide email dated 02 May 2024. However, no inputs have been received.

In the last meeting, the Committee deliberated on the comments received from HPPCL and decided the inputs may be forwarded to CEA for their views, for discussion in the next meeting. In this regard, the reminder was sent to CEA vide email dated 02 May 2024 to seek their views. However, no inputs have been received.

The Committee may NOTE & DECIDE.

ITEM 8 STANDARDS TAKEN FOR REVISION

Sl. No.	IS Number	IS Title	Panel members to whom the standard allotted
1.	IS 4880 (Part 1) : 1987	Code of practice for design of tunnels conveying water Part 1 general design First Revision	SJVNL - Shri Rakesh Sehgal, Shri Revati Raman CWPRS - Shri Y N Srivastava, Shri M. K. Verma, Mrs. Sushma Vyas NHPC - Ms. Shashi Prasad, Sh. Arunesh Bihari Dwivedi CWC - Ms. K Rekha Rani
2.	IS 5878 (Part 1) : 1971	Code of practice for construction of tunnels conveying water Part 1 precision survey and setting out	SJVNL - Shri Rakesh Sehgal, Shri Revati Raman THDC - Shri Anirudh Bishnoi, Shri Atul Jain CWC - Ms. K Rekha Rani
3.	IS 7916 : 1992	Open power channels - Code of practice First Revision	Prof. Nayan Sharma (in personal capacity) CWPRS - Shri Y N Srivastava, Shri M. K. Verma, Mrs. Sushma Vyas IIT Roorkee - Prof Zulfequar Ahmad THDC - Shri Anirudh Bishnoi, Shri Atul Jain CWC - Shri Narendra Singh Shekhawat
4.	IS 11388 : 2012	Recommendations for design of trash racks for intakes Second Revision	SJVNL - Shri Rakesh Sehgal, Shri Revati Raman CWPRS - Shri Y N Srivastava, Shri M. K. Verma, Mrs. Sushma Vyas NHPC - Ms. Shashi Prasad, Sh. Arunesh Bihari Dwivedi

			THDC - Shri Anirudh Bishnoi, Shri Atul Jain CWC - Ms. K Rekha Rani
5.	IS 11639 (Part 3) : 1996	Structural design of penstock - Criteria Part 3 specials for penstocks	SJVNL - Shri Rakesh Sehgal, Shri Revati Raman HPPCL - Er. R.K. Kaundal Er. Sanjay Kumar Rana THDC - Shri Anirudh Bishnoi, Shri Atul Jain CWC - Shri Narendra Singh Shekhawat,
6.	IS 12633 : 1989	First filling and emptying of pressure tunnels - Guidelines	SJVNL - Shri Rakesh Sehgal, Shri Revati Raman THDC - Shri Anirudh Bishnoi, Shri Atul Jain CWC - Ms. K Rekha Rani
7.	IS 13495 : 1992	Design of sediment excluders - Guidelines	CWPRS - Shri Y N Srivastava, Shri M. K. Verma, Mrs. Sushma Vyas NHPC - Ms. Shashi Prasad, Sh. Arunesh Bihari Dwivedi CWC - Shri Narendra Singh Shekhawat
8.	IS 15310 : 2003	Hydraulic design of pump sumps and intakes - Guidelines	CWPRS - Shri Y N Srivastava, Shri M. K. Verma, Mrs. Sushma Vyas IIT Roorkee - Prof Zulfequar Ahmad NHPC - Ms. Shashi Prasad, Sh. Arunesh Bihari Dwivedi CWC - Ms. K Rekha Rani

In the previous meetings, the Committee decided the composition of ad-hoc panel as above. The Committee requested the panel members to review the allotted standards for revision, and give recommendations on the received inputs. In this regard, six panel meetings were held and decisions taken by the panel members on the allotted standards are attached along with the agenda for review of the committee members. In the last meeting, the Committee decided to take up the matter in the next meeting.

Progress of panels shall be reviewed along with the allotted standards. IS 4880 (Part 1), IS 13495 and IS 15310 may be first taken up for discussion.

The Committee may NOTE & DECIDE.

ITEM 9 NEW SUBJECTS FOR CONSIDERATION

9.1 Guidelines for Design of Branching in Penstocks for Hydro Electric Projects

{Earlier Doc. No. WRD14 (496)}

In the last meeting, the Committee deliberated on the status of the document and SNC Lavalin informed that they are working on the subject and agreed to provide the

preliminary draft by the end of Jan 2024. In this regard, the reminder was sent vide email dated 02 May 2024 to expedite the submission of the pending draft. However, no inputs have been received.

The Committee may NOTE & DECIDE.

ITEM 10 ANY OTHER BUSINESS

10.1 Date and venue for the next meeting

ANNEX 1

COMPOSITION OF WATER CONDUCTOR SYSTEMS SECTIONALCOMMITTEE, WRD 14

Scope: *Standardization of criteria for planning, design, construction, maintenance and related aspects of all components of water conductor systems.*

Last 3 meetings	**20th - 29 August 2022**	**21st – 27 March 2023**	**22nd – 11 December 2023**

SL. NO.	**NAME OF THE ORGANIZATION**	**REPRESENTED BY**	**MEETINGS ATTENDED**		
			20th	**21st**	**22nd**
1.	CENTRAL WATER COMMISSION, NEW DELHI	SHRI VIJAI SARAN, CHIEF ENGINEER DESIGNS (NW&S) [CHAIRPERSON]	Y	Y	Y
2.	BHAKRA BEAS MANAGEMENT BOARD, NANGAL TOWNSHIP	SHRI G. S. NARWAL DIRECTOR (WATER REGULATION) (*Alternate*)	X	X	X
3.	CENTRAL ELECTRICITY AUTHORITY, NEW DELHI	SHRI MUKESH KUMAR, DEPUTY DIRECTOR, SHRI REETESH TIWARI, DEPUTY DIRECTOR (Alternate)	NR	NR	NR
4.	CENTRAL SOIL & MATERIALS RESEARCH STATION, NEW DELHI	SHRI HARI DEV, SCIENTIST E SH. M. RAJA, SCIENTIST D (*Alternate*)	Y	X	X
5.	CENTRAL WATER & POWER RESEARCH STATION, PUNE	SHRI M. K. VERMA, SCIENTIST D MRS. SUSHMA VYAS, SCIENTIST C (*Alternate*) SHRI M. Z. QAMAR (*Alternate*)	Y	Y	Y
6.	CENTRAL WATER COMMISSION, NEW DELHI	MS. K REKHA RANI, DIRECTOR, HCD(E&NE) SHRI NARENDRA SINGH SHEKHAWAT, DIRECTOR, HCD (N&W) (*Alternate*)	Y	Y	Y
7.	CENTRAL INSTITUTE OF MINING & FUEL RESEARCH, ROORKEE	DR. MORE RAMULU DR. ABHAY KUMAR SINGH (*Alternate*)	Y	Y	Y
8.	DELHI TECHNOLOGICAL UNIVERSITY, DELHI	PROF. S K SINGH DR. ANIL KUMAR HARITASH (*Alternate*)	X	X	X
9.	GEOLOGICAL SURVEY OF INDIA, FARIDABAD	SHRI D. P. DONGWAL, DIRECTOR DR. AJAY KUMAR, DIRECTOR (*Alternate*)	Y	X	Y
10.	GUJARAT ENGINEERING RESEARCH INSTITUTE,(GERI)	SHRI N. R. MAKWANA, JOINT DIRECTOR (IRRIGATION) SHRI V.R.RATHWA, RESEARCH OFFICER (I/C) (*Alternate*)	Y	Y	X

11.	HIMACHAL PRADESH POWER CORPORATION LIMITED, SUNDERNAGAR	SHRI ER. R. K. KAUNDAL, GENERAL MANAGER (DESIGNS) SHRI SANJAY RANA DEPUTY GENERAL MANAGER (*Alternate*)	Y	X	Y
12.	HINDUSTAN CONSTRUCTION COMPANY LIMITED, MUMBAI	SHRI SURYARAO CHALAMKURI SHRI PRAVEEN SHETTIGAR (*Alternate*)	X	X	X
13.	INDIAN INSTITUTE OF ENGINEERING SCIENCE & TECHNOLOGY, SHIBPUR	PROF. SUJATA BISWAS	X	X	Y
14.	INDIAN INSTITUTE OF TECHNOLOGY, JODHPUR	PROF P. K. TEWARI	Y	X	Y
15.	INDIAN INSTITUTE OF TECHNOLOGY KANPUR	PROF. ABHAY KARANDIKAR PROF. ASHU JAIN (Alternate)	X	X	X
16.	INDIAN INSTITUTE OF TECHNOLOGY, MANDI	DR. DEEPAK SWAMI	X	X	Y
17.	INDIAN INSTITUTE OF TECHNOLOGY ROORKEE	PROF. ZULFEQUAR AHMAD, CED PROF. M K SINGHAL, HRED (Alternate)	Y	Y	Y
18.	IRRIGATION RESEARCH INSTITUTE, ROORKEE	SHRI DINESH CHANDRA, C.E. SHRI NAVEEN SINGHAL, SUPERINTENDING ENGINEER (Alternate)	Y	X	Y
19.	LARSEN & TOUBRO LIMITED FARIDABAD	SHRI SATYAJEET SINHA	-	Y	Y
20.	NATIONAL HYDROELECTRIC POWER CORPORATION LIMITED, FARIDABAD	SHRI SANKHADIP CHOWDHURY, GENERAL MANAGER (CIVIL) SH. ARUNESH BIHARI DWIVEDI, DEPUTY GENERAL MANAGER (CIVIL), MS. SHASHI PRASAD, DEPUTY MANAGER (CIVIL), (Alternate)	X	Y	Y
21.	NORTH EASTERN ELECTRIC POWER CORPORATION LIMITED, SHILLONG	SHRI B. KALITA, DEPUTY GENERAL MANAGER	X	X	Y
22.	NTPC LTD., NOIDA	SHRI NAVEEN KUMAR JAIN SHRI NIRAJ KUMAR (Alternate)	X	X	X
23.	PES ENGINEERS PVT. LIMITED	SHRI S.V.S.S. RAJU, VP (DESIGNS) DR. V. SURYA ANANTPANTULA, GM (DESIGNS) (Alternate)	X	Y	Y

24.	SJVN LTD., NEW SHIMLA	SHRI RAKESH SEHGAL SHRI REVATI RAMAN (Alternate)	Y	Y	Y
25.	SNC LAVALIN, NEW DELHI	SHRI ARUN MEHTA PRACTICE MANAGER, WATERPOWER & DAMS SHRI JAIGANESH SATHYAMURTHY, ASSOCIATE PRINCIPAL ENGINEER	X	Y	Y
26.	THDC INDIA LTD, RISHIKESH	SHRI ATUL JAIN SHRI MAYANK KUMAR (Alternate) SHRI ASHISH KUMAR (Alternate)	Y	Y	Y
27.	WATER RESOURCES DEPARTMENT (BODHI) MADHYA PRADESH	SHRI G. P. SONI SHRI DEEPAK SATPUTE (Alternate)	X	X	X
28.	WATER RESOURCES DEPARTMENT, MAHARASHTRA	SUPERINTENDING ENGINEER, LIFT IRRIGATION SCHEME CIRCLE EXECUTIVE ENGINEER, LIFT IRRIGATION SCHEME DIVISION-1 (Alternate)	X	X	X
29.	IN PERSONAL CAPACITY	DR. NAYAN SHARMA	X	Y	Y
30.	IN PERSONAL CAPACITY	PROF. GOPAL DAS SINGHAL	X	X	Y

ANNEX 2

WRD14: WATER CONDUCTOR SYSTEMS

SCOPE: Standardization of criteria for planning, design, construction, maintenance and relatedaspects of all components of water conductor systems.

STANDARDS PUBLISHED

Sl. No.	IS No.	Title	Reaffirm
1.	IS 4410 Part 20 : 1983	Glossary of terms relating to river valleyprojects Part 20 tunnels	Feb- 2020
2.	IS 4880 Part 1 : 1987	Code of practice for design of tunnels conveying water Part 1 general designFirst Revision	Mar-2022
3.	IS 4880 Part 2 : 1976	Code of practice for design of tunnels conveying water Part 2 geometric designFirst revision	Feb- 2020
4.	IS 4880 Part 3 : 1976	Code of practice for design of tunnels conveying water Part 3 hydraulic designFirst Revision	Feb- 2020
5.	IS 4880 Part 4 : 1971	Code of practice for design in tunnels conveying water Part 4 structural designof concrete lining in rock	Feb- 2020
6.	IS 4880 Part 5 : 1972	Code of practice for design of tunnels conveying water Part 5 structural designof concrete lining in soft strata and soils	Feb- 2020
7.	IS 4880 Part 6 : 1971	Code of practice for design of tunnels conveying water Part 6 tunnel supports	Feb- 2020
8.	IS 4880 Part 7: 2014	Code of practice for design of tunnels conveying water Part 7 structural design ofsteel lining First Revision	Feb- 2020
9.	IS 5330 : 1984	Criteria for design of anchor blocks for penstocks with expansion joints First Revision	Feb- 2020
10.	IS 5878 Part 1 : 1971	Code of practice for construction of tunnels conveying water Part 1 precisionsurvey and setting out	Mar-2022
11.	IS 5878 Part 2 Sec 1 : 1970	Code of practice for construction of tunnels Part 2 underground excavation in rock Sec 1 drilling and blasting	Feb- 2020
12.	IS 5878 Part 2 Sec 2 : 1971	Code of practice for construction of tunnels Part 2 underground excavation inrock Sec 2 ventilation, lighting, mucking and dewatering	Feb-2020
13.	IS 5878 Part 2 Sec 3 : 1971	Code of practice for construction of tunnels conveying water Part 2 underground excavation in rock section 3 tunnelling method for steeply inclined tunnels shafts and underground power houses	Feb-2020

14.	IS 5878 Part 3 : 1972	Code of practice for construction of tunnels Part 3 underground excavation insoft strata	Feb- 2020
15.	IS 5878 Part 4 : 1971	Code of practice for construction of tunnels conveying water Part 4 tunnelsupports	Feb- 2020
16.	IS 5878 Part 5 : 1976	Code of practice for construction of tunnels conveying water Part 5 concretelining First Revision	Feb- 2020
17.	IS 5878 Part 6 : 1975	Code of practice for construction oftunnels Part 6 steel lining	Feb- 2020
18.	IS 5878 Part 7 : 1972	Code of practice for construction of tunnels conveying water Part 7 grouting	Feb- 2020
19.	IS 7357 : 1974	Code of practice for structural design ofsurge tanks	Feb- 2020
20.	IS 7396 Part 1 : 1985	Criteria for hydraulic design of surge tanksPart 1 simple restricted orifice and differential surge tanks First Revision	Feb- 2020
21.	IS 7396 Part 2 : 1985	Criteria for hydraulic design of surge tanksPart 2 tail race surge tanks First Revision	Feb- 2020
22.	IS 7396 Part 3 : 1990	Criteria for hydraulic design of surge tanksPart 3 special surge tanks	Feb- 2020
23.	IS 7396 Part 4 : 1983	Criteria for hydraulic design of surge tanksPart 4 multiple surge tanks	Feb- 2020
24.	IS 7563 : 1986	Code of practice for structural design of cut and cover concrete conduits FirstRevision	Feb- 2020
25.	IS 7916 : 1992	Open power channels - Code of practiceFirst Revision	Mar-2022
26.	IS 9761 : 1995	Hydropower intakes - Criteria for hydraulicdesign First Revision	Feb- 2020
27.	IS 11105 : 2004	Design and Construction of Tunnel Plugs -Code of Practice	Feb- 2020
28.	IS 11388 : 2012	Recommendations for design of trashracks for intakes Second Revision	Sep- 2022
29.	IS 11625 : 1986	Criteria for hydraulic design of penstocks	Feb- 2020
30.	IS 11639 Part 1 : 1986	Criteria for structure design of penstocksPart 1 surface penstocks	Feb- 2020
31.	IS 11639 Part 2 : 1995	Structural design of penstocks - Criteria Part 2 buried/embedded penstocks in rock	Feb- 2020
32.	IS 11639 Part 3 : 1996	Structural design of penstock - Criteria Part3 specials for penstocks	Mar-2022
33.	IS 12633 : 1989	First filling and emptying of pressuretunnels — Guidelines	Mar-2022
34.	IS 12967 Part 1 : 1990	Analysis of hydraulic transients in hydro -Electric and pumping plants - Code of practice Part 1 criteria for	Feb- 2020

		analysis	
35.	IS 13495 : 1992	Design of sediment excluders - Guidelines	Mar-2022
36.	IS 15310 : 2003	Hydraulic design of pump sumps and intakes - Guidelines	Mar-2022
37.	IS 16173 : 2014	Criteria for hydraulic design of sediment removal devices for hydro power projects First Revision	Feb- 2020

ANNEX 3

(Item 6.1 & 6.2)

Title: IS 7396 (Part 1): 1985, Criteria for Hydraulic Design of Surge Tanks- Simple Restricted Orifice and Differential S urge tanks

Sl. No.	Committee/ Organization /Individual	Clause/ Sub clause Paragraph Figure/Table	Type of Comment General/ Technical /Editorial	Comments (Justification For Change)	Proposed Change
1.	WRD 14/Committee/ NHPC	Clause-5 Design (page-9)	Technical	Definition of "**Specified Load Acceptance"** is not mentioned anywhere in code.	New **para 5.1.2** may be added as described below: "Guidelines for Specified Load Acceptance areas per attached Annex B." **Annex B:** Content of Part of Committee report from **Paragraph 9.1 to 16** of the "*Report of the Committee for Framing Guidelines on Load Acceptance Criteria for Hydro-electric Plants*" as

					attached as **Annex B**.

Title: IS 7396 (Part 2): 1985, (Reaffirmed 2020) Criteria for Hydraulic Design of Surge Tanks- Tail Race Surge Tanks

Sl. No.	**Committee/ Organization/ Individual**	**Clause/ Sub clause Paragraph Figure/Table**	**Type of Comment General/ Technical / Editorial**	**Comments (Justification For Change)**	**Proposed Change**
1.	WRD 14/Committee/ NHPC	Clause-5 Design (page-9)	Technical	Definition of "**Specified Load Acceptance"** is not mentioned anywhere in code.	New **para 5.1.2** may be added as mentioned below: Please refer **Annex B** of IS 7396 (Part 1): 1985 for details of Guidelines for 'Specified Load

					Acceptance’ .

ANNEX B

(Clause 5.1.2)

GUIDELINES ON LOAD ACCEPTANCE CRITERIA FOR HYDRO-ELECTRIC PLANTS

B.1 Case-1: Load rejection by all operative machines followed by load acceptance by all machines (100-0-100)

B.1.1 Ramping up of load for all the Units together: When simultaneous loading of units is done through manual or joint control mode of operation from speed, No-load condition, the ramping rate is limited to 1.5MW/sec to 2MW/sec as per graph given in Figure-B-1 below:

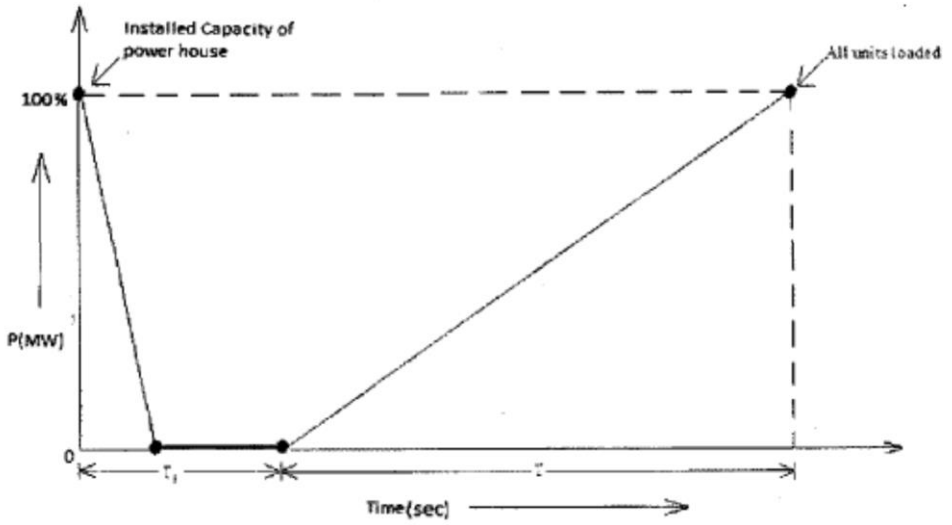


Figure-B-1: Simultaneous loading of units

The total time of needle/guide vane opening from speed no-load condition to full load 'T' shall not be less than T_s obtained from Criteria given in para B.1.3.

B.1.2 Starting of all units together shall generally be not recommended after load throw-off as the malfunctioning of the hardware/software interlocks in the process may inadvertently increase the ramping-up rate of units. However, the same may adopted if proper functioning of the hardware/software interlocks is assured by the project authorities.

B.1.3 Ramping up of load for Units one by one: When loading of units are done one by one through manual or auto control mode of operation from Speed No-Load condition. The ramping-up of the load shall be done as per procedure given hereunder and shown in Figure- B-2 below:

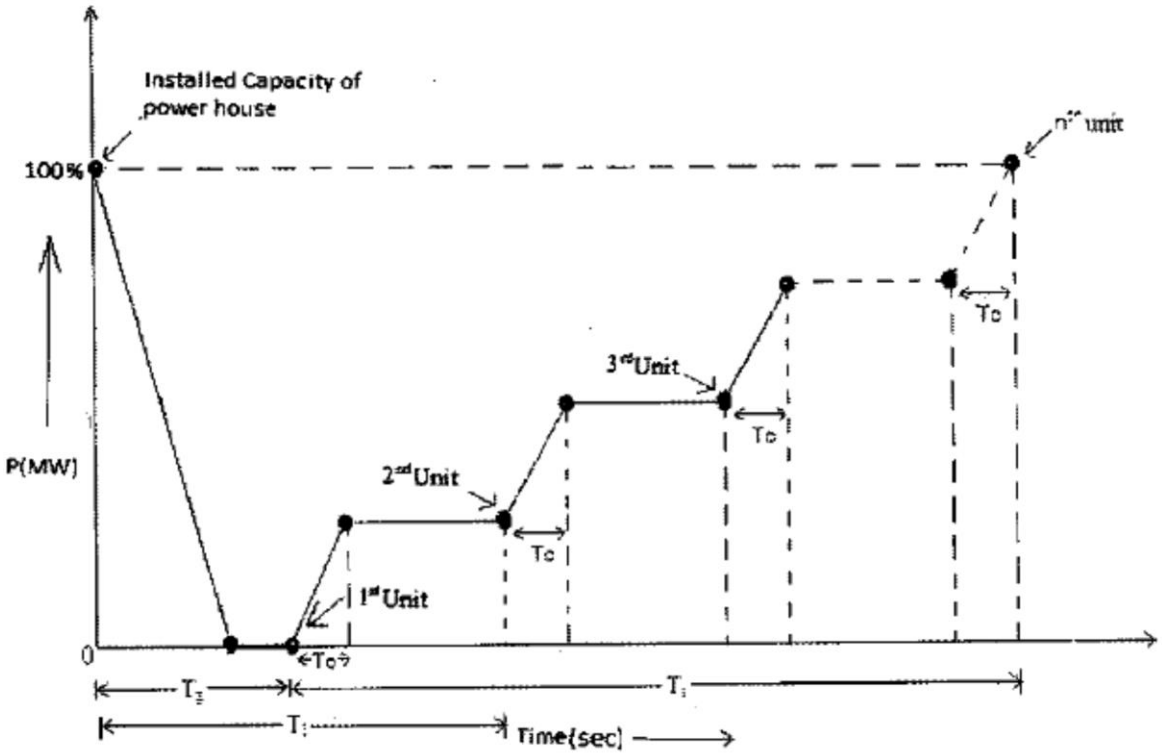


Figure-B-2: Ramping up of load for Units one by one

a) The needle/guide vane of unit shall be opened in 20-60 seconds as per manufacturer's recommendation (To)

b) The second unit shall be loaded only after time T1 such that

$$T_1 \geq 2\pi\sqrt{(L*As/g*At)}$$

where: L is length of HRT in meters

As is area of surge tank in m^2

At is area of HRT in m^2

g is acceleration due to gravity in m/sec^2

Tg is the time in sec. from the instant of unit tripping to the start of first unit

Ts is total time of opening of all the units in sec

T_0 is the time of needle/guide vane opening of one unit in sec,

T_1 is the time in sec. from tripping of unit to opening of needle/guide vane of second unit

c) Total time of opening of needle/guide vane shall not be less than time T which is equal to installed capacity divided by the ramp rate defined for all the units are loaded together i.e. 1.5 MW/sec to 2 MW/sec.

d) The time gap for 3rd unit till last unit shall be obtained by subtracting the time up to loading of 2nd unit from total time and dividing that by number of remaining units.

Note: i) T_1 is the time of water oscillation in the simple surge tank for frictionless system. Hence it is advisable to obtain correct value of T_1 from the surge analysis for 100-0-0 operating condition.

ii) Where continuous overload capacity has been specified, the maximum power output shall be considered as full load throw-off.

B.1.4 Simultaneous loading of two units can be considered for hydro-electric power plants having more than four units.

B.2 Case 2: Load acceptance by all operative machines and continue to run at plant installed capacity as 0-100-100 condition.

B.2.1 Ramping up of load for all the Units together: When simultaneous loading of units is done through manual or joint control mode of operation from speed No-Load condition the ramping rate is limited to 2.5 MW/sec to 3.0 MW/sec as per graph indicated Figure-B-3 below:

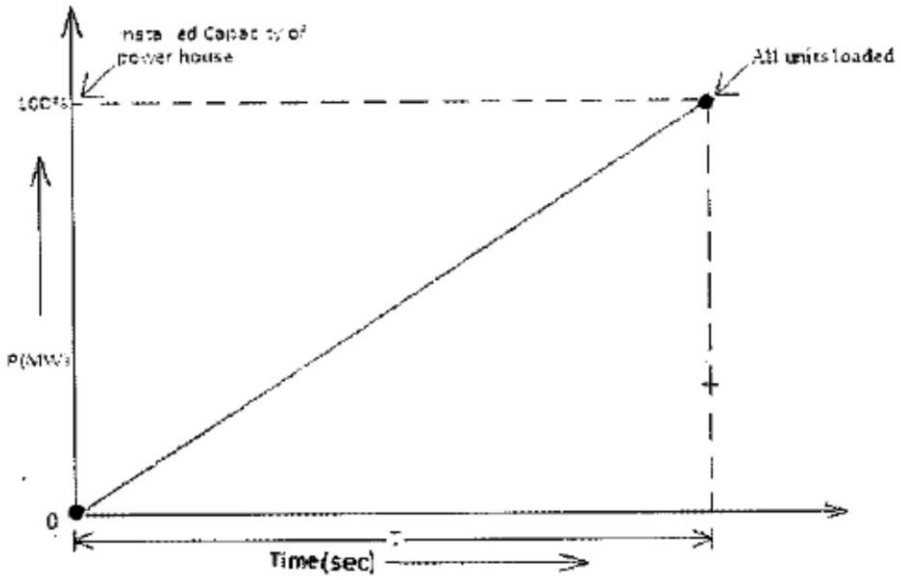


Figure-B-3: Ramping up of load for all the Units together

However, the total time of needle/guide vane opening from speed no-load condition to full load 'T' shall not be less than 'Ts' obtained from criteria given in Para B.2.3.

B.2.2 Similar to para 9.1.2, the starting of all units together for 0-100-100 condition shall generally be not recommended, as in this case also any malfunction of hardware/software interlock or operator mistake may inadvertently increase ramp-up rate of units. However, the same may be adopted if proper functioning of interlocks is ensured by the project authorities.

B.2.3 Ramping up of load for units one by one: When loading of units are done one by one through manual or auto control mode of operation from Speed No-Load condition the ramping shall be done as per procedure given here under & Figure-B-4.

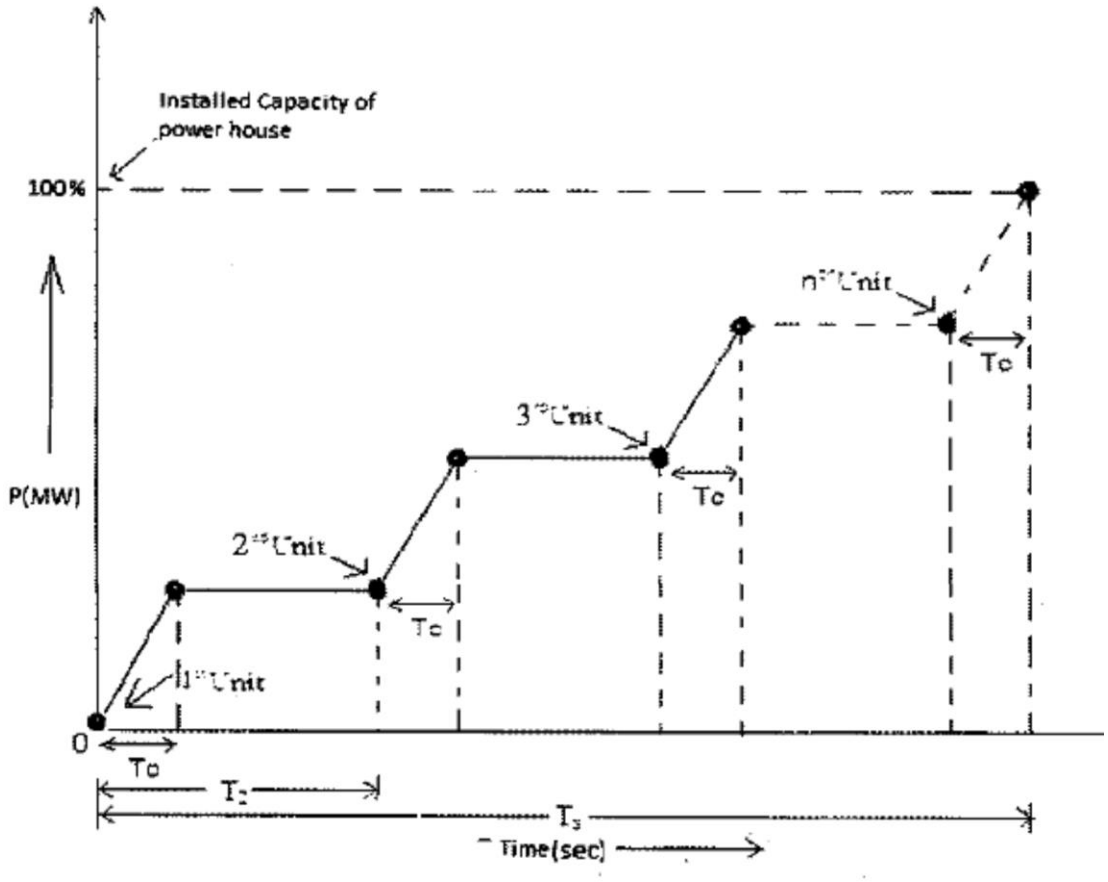


Figure-B-4: Ramping up of load for Units one by one

a) The needle/guide vane of unit shall be opened in 20-60 seconds as per manufacturer's recommendation (To)

b) The second unit shall be loaded only after time T_2 such that

$$T_2 = \pi\sqrt{(L*As/g*A_t)}$$

where: L is length of HRT in meters

As is area of surge tank in m^2

At is area of HRT in m^2

g is acceleration due to gravity in m/sec^2

Ts is total time of opening of all the units in sec

T_0 is the time of needle/guide vane opening of one unit in sec,

T_2 is the time of start of needle/guide vane opening of second unit from beginning in sec.

c) Total time of opening of needle/guide vane 'Ts' shall not be less than time 'T' which is equal to installed capacity divided by the ramp rate defined for all the units are loaded together i.e. 2.5MW/sec to 3MW/sec.

d) The time gap for 3rd unit till last unit shall be obtained by subtracting the time up to loading of 2nd unit from total time and dividing that by number of remaining units.

Note: T_2 is the time of half oscillation in the simple surge shaft for frictionless system. Hence, it is advisable to obtain correct value of T_2 from the surge analysis for 0-1 unit-1 unit operating condition.

B.2.4 Similar to para B.1.4, simultaneous loading of two units can be considered for hydro- electric power plants having more than four units.

B-3. To further clarify the above stipulations a typical illustration has been made at Annexure-A.

B-4. The above guidelines are applicable for all hydro scheme having HRT & surge shaft. However, for Dam toe projects there would be no restriction on load acceptance criteria and the loading guidelines as recommended by the manufacturer, shall be applicable.

B-5. These load acceptance criteria shall be made only to new hydro-electric scheme being planned considering these guidelines. However, the plants already built shall continue to operate as per operational guidelines approved by the respective utility.

B-6. Necessary provision shall be made in unit and plant control system which could detect the initial condition from which the plant shall be started so that the ramp up constraints could be effectively followed.

B-7. Infra-red light based sensors in surge shaft may be used, wherever feasible so that water level in the surge shaft could be monitored and in the event of water level falling below the critical level during down surge, control action would initiate to stop the units.

Annexure-A

Typical Illustration for 100-0-100 and 0-100-100 condition

Assuming basic parameters of a hydro-electric plant as under:

Installed Capacity = 6 x 200 MW

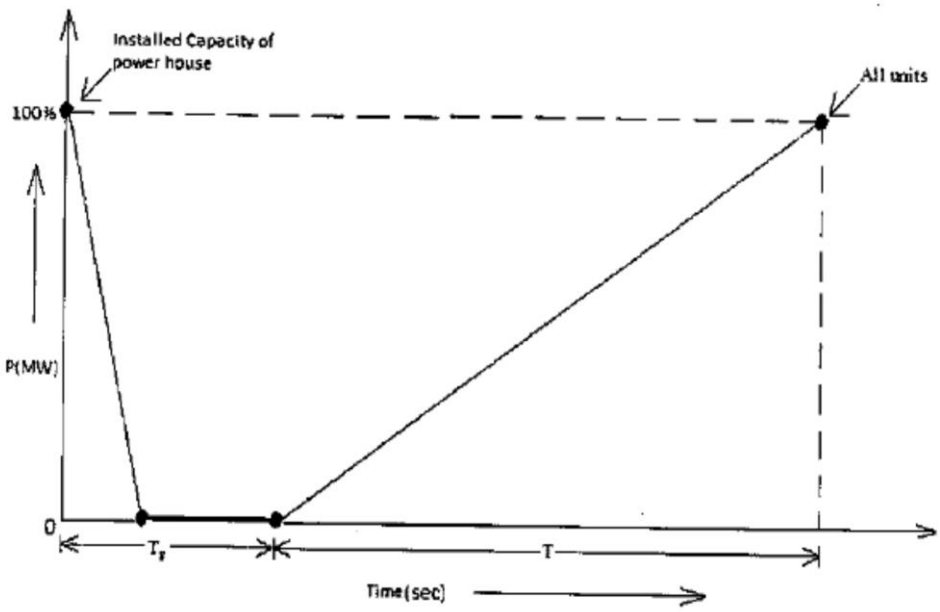
Length of HRT = 9000m

Area of HRT = 78.5 m^2

Area of Surge shaft = 471.4 m^2

i) 100-0-100 operating condition:

a) Ramping up all units together at rate of 2MW/sec (Say)



T = 1200/2 = 600 sec.

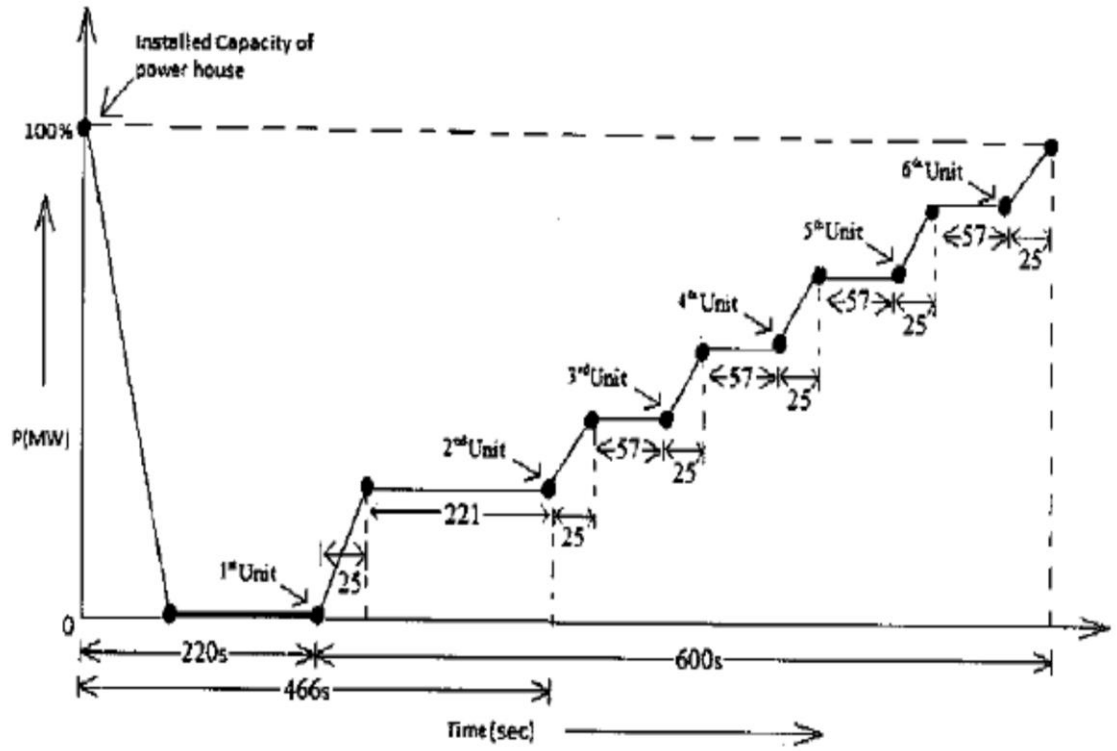
b) Loading of units one by one

$$T = 2\pi\sqrt{(L*As/g*At)}$$

= 466 sec.

The second unit shall start after 466 sec from the instance tripping occurs.

Let us assume that first unit starts after 220 seconds from the instance tripping occurs. In this case, load acceptance curve becomes as given in the following figure.



Total time of opening of all units = 600 sec.

Time of opening of guide vanes of one unit = 25 sec. (say)

Time gap between start of second unit after opening of first unit = 4600-220-25 = 221 sec.

Time gap between start of other units after opening of previous unit = [600-221-(25x6)]/4 = 57 sec (approx.)

ii) <u>0-100-100 operating condition</u>

a) Ramping up all units together at the rate of 2.5 MW/sec. (say) T = 1200/2.5 = 480 sec.
b) Loading of units one by one T_1 = 233 sec.

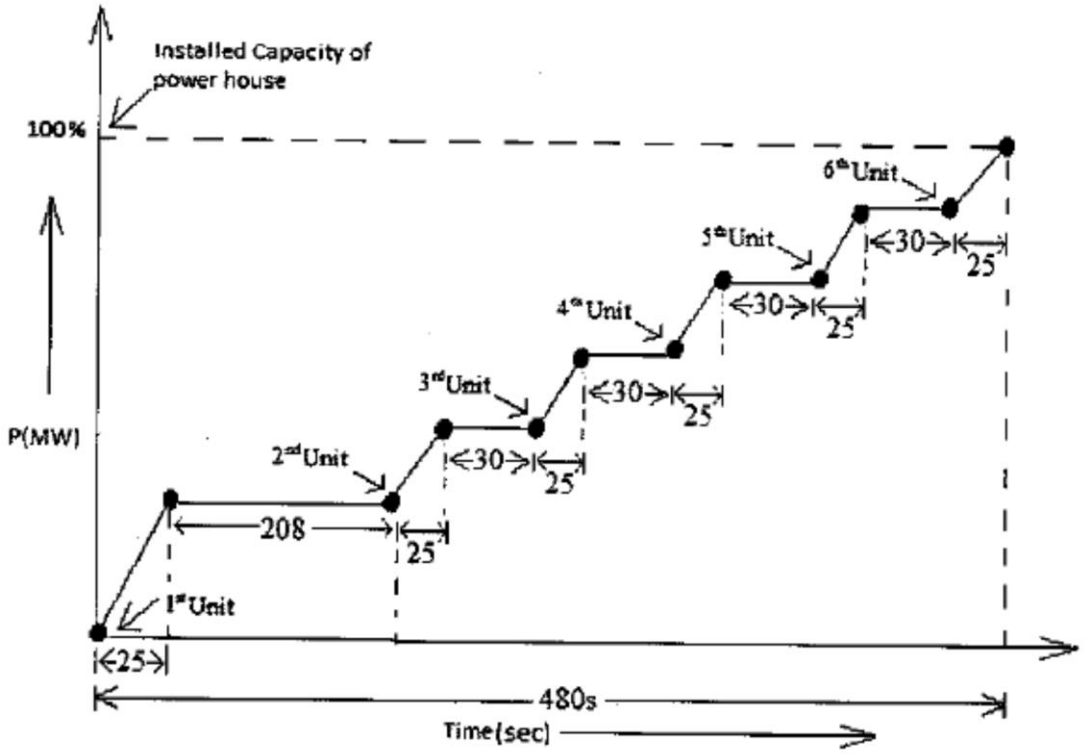
Second unit shall start after 233 seconds from the instance first unit starts. Total time of opening of all units = 480 sec.

Time of opening of guide vanes of one unit = 25 sec (say)

Time gap between start of send unit after opening of first unit = 233-25 = 208 sec.

Time gap between start of other units after opening of previous unit

= [480-208-(25 x 6)]/4 = 30 sec.


Installed Capacity of power house
100%
P(MW)
1st Unit
2nd Unit
3rd Unit
4th Unit
5th Unit
6th Unit
208
25
30
25
30
25
30
25
30
25
25
480s
Time(sec)

ANNEX 4

Comments from SJVN Limited:

5.1Title: IS 7396 (Part 1): 1985, Criteria for Hydraulic Design of Surge Tanks- Simple Restricted Orifice and Differential Surge tanks

Sl. No.	Committee/ Organization/ Individual	Clause/ Subclause Paragraph Figure/Table	Type of Comment General/ Technical / Editorial	Comments (Justification For Change)	Proposed Change
1	WRD 14/Committee/SJVN	5.3.3	Technical	Effect of other cooperating power stations on stability of one under consideration has not been explained.	New Para **5.3.4** may be added as mentioned below **Stabilising effect of grid:** *"The effect of co-operating power plants to one under consideration is favourable if the total power output of the plants without surge tanks in the energy system is relatively high. The stability of the power plant is thus improved if there are thermal stations and run-of-river power plants supplying the same network. Co-operating high-head power plants with surge tanks ensuring a stability considerably in excess of the one investigated have also a beneficial effect on stability. These should, however, be neglected, and thermal as well as run-of-river power stations, both of which may be considered completely stable, will only be allowed for in the investigation. Their aggregate power capacity in the co-operating system should be taken as N_{st}. The power of the plant under consideration be N.* *The ratio K= $\frac{N}{Nst+N}$ has been shown to have a decisive*

					significance in stability problems. *For the case when the plant under consideration is the only power supplier to the network, i.e. if K = 1, the Thoma formula is obtained in its original form equation (5). If, however, the capacity of the cooperating stable power plants attains the value 2 N, i.e. if K decreases to 1/3, then A_{th} =0.The conclusion to be drawn from this result is that whenever the capacity ratio K ≤1/3, the stability of the plant examined is guaranteed by the co-operating stable plants, regardless of the size of its surge tank."* **Annexure. A is enclosed as supporting literature.**