BUREAU OF INDIAN STANDARDS

AGENDA

24th Meeting of Water Conductor Systems Sectional Committee, WRD 14		
Day and Date	**Time**	**Venue :**
Thursday, 12 Dec 2024	From **10:30 A.M.**	Hybrid For Physical Participation: Conference Room, 3rd Floor, CWC, Sewa Bhawan, RK Puram 1, New Delhi
Link for virtual participation: https://bismanak.webex.com/bismanak/j.php?MTID=m16811600294992022de7a647fcbd4744		
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 23rd meeting of the WRD 14 Sectional Committee was held on 03 June 2024 and the minutes duly approved by the Chairperson were circulated vide BIS email dated 14 June 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 NOTE & REVIEW.

2.2 Following additional member nominations has been received from the member organization.

Sl. No.	**Organization**	**Name of the Nominated Member**
1.	Indian Institute of Technology BHU, Varanasi	Dr Prabhat Kumar Singh Dikshit, Professor (*Alternate II*)

The Committee may NOTE.

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.

The Committee may NOTE.

Item 4 DRAFT STANDARD COMPLETED WIDE CIRCULATION

4.1 Doc. No. WRD 14(26562) DESIGN OF TUNNELS CONVEYING WATER PART 1 GENERAL DESIGN - CODE OF PRACTICE [Second Revision of IS 4880 (Part 1): 1987]

During its last meeting, the Committee acknowledged and deliberated on the inputs received from experts assigned to review the standard. It also discussed the final views of the panel (WRD 14/P-1) regarding these inputs. The Committee resolved all comments, and the revised document, incorporating these resolutions, was put into wide circulation on 13/09/2024 for a 60-day review period. Stakeholders across the country were invited to provide feedback during this time. The wide circulation stage has now concluded, and no comments were received. The document is attached to the agenda for reference.

The Committee may NOTE and DECIDE.

Item 5 DRAFT DOCUMENTS UNDER PRELIMINARY CIRCULATION

5.1 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 Dropped Document No. 18185)

In its last meeting, the Committee deliberated on and updated the composition of the working group (WRD 14/WG-1) as detailed below. The Committee also tasked the working group with reconciling the formulae in Annex D of the draft document for discussion in the next meeting.

1. Shri Sankhadip Chowdhary, National Hydroelectric Power Corporation (Convenor, WRD 14/WG-1)
2. Representative from the Geological Survey of India
3. Shri Hari Dev, Central Soil & Materials Research Station
4. Representative from the Central Institute of Mining & Fuel Research
5. Prof. K. K. Pandey, IIT BHU
6. Prof. Prabhat Kumar Singh Dikshit, IIT BHU

The working group held meetings on 30/08/2024 and 03/10/2024, during which the draft document was concluded. The revised draft, along with track changes, is attached to the agenda for the Committee's review. Additionally, Prof. K. K. Pandey submitted further comments on the draft document, which are placed in Annex 3 for the Committee's deliberation.

The Committee may NOTE and DECIDE

5.2 IS 9761: 1995 Hydropower intakes – Criteria for Hydraulic Design [Second Revision of IS 9761]

(Earlier Dropped Document No. 19357)

10/09/2024 In the last meeting, the Committee requested the working group members (WRD 14/WG 2) to expedite the finalization of the document and decided to drop the earlier document and adopt the document as finalized by the working group. The Committee also requested the Member Secretary to circulate the finalized document as received from the working group as a P-draft document for seeking views/comments from the Committee members.

The Composition of WRD14/WG-2:

1. Director. HCD (E&NE), CWC (Convenor)

2. Representative from Central Water & Power Research Station

3. Representative from IIT Roorkee

4. Prof. Nayan Sharma, In Personal Capacity

5. Representative from National Hydroelectric Power Corporation

6. Representative from THDC India Limited

7. Representative from SJVN Limited

In this regard, working group meeting was convened on 10/09/2024 and the final document as received from CWC (also circulated vide email dated 04 Dec 2024) is attached with the agenda for the Committee's review. THDC has provided figure showing the layout of Intake for Pumped Storage scheme (in replacement of figure XX in the circulated draft) as placed in Annex 4 for deliberation.

The Committee may NOTE and DECIDE.

ITEM 6 STANDARDS TAKEN FOR REVISION UNDER PANEL (WRD 14/P-1)

Sl. No.	IS Number	IS Title	Panel members to whom the standard allotted
1.	IS 4880 (Part 1) : 1987 (Concluded *see* **4.1)**	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	SJVNL - Shri Rakesh Sehgal, Shri Revati Raman

		precision survey and setting out	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

6.1 In the last meeting, the Committee discussed & resolved comments received on IS 13495: 1992 Design of sediment excluders – Guidelines from experts except comment no. 5 where Committee requested panel to discuss in next meeting and submit its recommendations. In this regard, panel meeting was held on 29 Nov 2024 and the panel decided to include the Modified Shields diagram provided by Prof Z Ahmed as provided below.

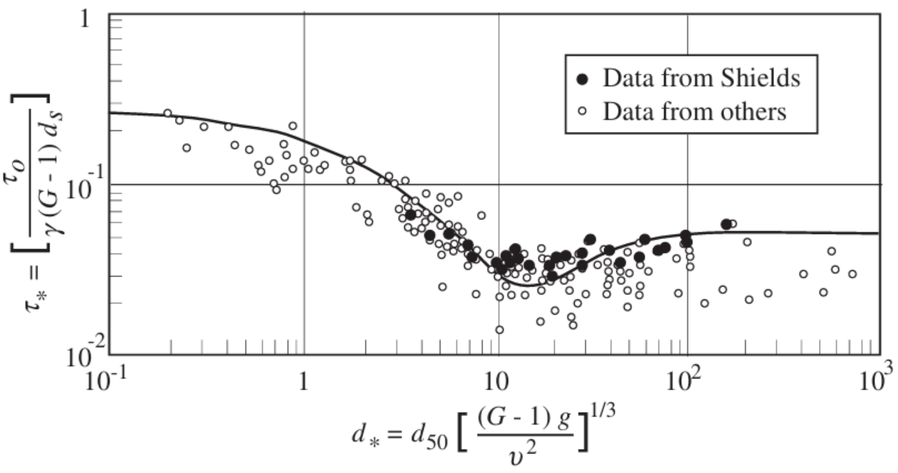


Figure 7.8. Modified Shields diagram

6.2 In the last meeting, the Committee referred back comments (Sl No **6** & **7**) on IS 15310 : 2003 'Hydraulic design of pump sumps and intakes – Guidelines' to discuss again in panel. The Panel meeting was held on 29 Nov 2024 and Dr Z Ahmed agreed to provide definitions of all the vortex given in the figure (ref Comment no 6) and concise the inputs on physical model studies of pump sumps without hampering the technical content as an annexure to the draft (ref Comment No 7). However, inputs of Prof Ahmed are awaited.

6.3 In the last meeting**,** the Committee requested panel to discuss inputs received on the other standards and decided to discuss the remaining documents in next meeting. In this regard, inputs received on IS 5878 (Part 1) : 1971, IS 12633 : 1989, IS 11639 (Part 3) : 1996 & IS 11388 : 2012 have been discussed and view of panel on all the comments has been attached with the agenda.

6.4 Further, Inputs received on IS 7916 from Prof Nayan Sharma & CWPRS on Comment no 3 & 5 have been circulated. However, comments are awaited from members.

The Committee may NOTE & DECIDE.

ITEM 7 COMMENTS ON PUBLISHED STANDARDS

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

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

In its last meeting, the Committee deliberated on inputs received from SJVN Limited and NHPC Limited regarding IS 7396 Part 1 (attached with Annex 5 & 6). Concerning the comments on load acceptance criteria, CEA clarified that the report referred to by NHPC had not been accepted by CEA. The Committee directed the Member Secretary to write to CEA requesting detailed input on the matter. Additionally, the Committee requested CEA and NHPC to provide information about other organizations that could offer relevant inputs and be considered for inclusion in the Committee. The Committee further resolved to form a working group, in consultation with the Chairperson, once details of such organizations were received.

Inputs were requested from CEA via BIS emails dated 09 July 2024 and 02 September 2024. CEA vide email dated 06 Dec 2024 informed the following:

'It may be noted that the report referred by NHPC has already been discussed in the last meeting and CEA representative clarified that the authenticity of the said report had never been accepted by CEA. Further, the parameters are machine sensitive and varied from machine to machine and from project to project under different operating conditions. These generalized Guidelines on load acceptance criteria for hydroelectric plants cannot be uniformly applied across all hydropower or pumped storage projects.'

The Committee may NOTE & DECIDE

ITEM 8 DRAFT DOCUMENTS UNDER REVISION

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

In its last meeting, the Committee deliberated on the status of the draft document that has been long pending from SNC Lavalin. To address this, the Committee decided to constitute a working group (WRD 14/WG-3) for the preparation of the draft document with the following composition:

1. Director, HCD (E&NE), CWC (Convenor)
2. Representative from National Hydro Power Corporation
3. Representative from THDC India Limited
4. Representative from SJVN Limited

The Committee directed the Member Secretary to contact SNC Lavalin to obtain the available draft document so the working group could proceed with its tasks. The Committee also authorized the Convenor of the working group (WRD 14/WG-3) to include additional experts from IITs as deemed appropriate.

In this regard, SNC Lavalin was requested to submit the long-pending inputs vide BIS email dated 03 July 2024. However, no response has been received.

Additionally, CEA is requested to provide views on comments received from HPPCL (as included in Annex 7) for further discussion within the working group (WRD 14/WG-3). No inputs have been received from CEA either.

The Committee may NOTE & DECIDE.

ITEM 9 NEW SUBJECTS UNDER CONSIDERATION

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

In the last meeting, the Committee deliberated on the status of the long pending document from SNC Lavalin and requested Member Secretary to obtain the available draft document so the working group (WRD 14/WG 3) could take up the subject further. In this regard, inputs were requested vide BIS email dated 03 July 2024. However, no response has been received. (*see* item **8.1**)

The Committee may NOTE & DECIDE.

ITEM 10 ANY OTHER BUSINESS

ANNEX 1

(*Clause 2.1*)

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	21st – 27 March 2023	22nd – 11 December 2023	23rd – 03 June 2024

SL. NO.	NAME OF THE ORGANIZATION	REPRESENTED BY	MEETINGS ATTENDED		
			21st	22nd	23rd
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	Y
3.	CENTRAL ELECTRICITY AUTHORITY, NEW DELHI	SHRI MUKESH KUMAR, DEPUTY DIRECTOR, SHRI REETESH TIWARI, DEPUTY DIRECTOR (*Alternate*)	NR	NR	Y
4.	CENTRAL SOIL & MATERIALS RESEARCH STATION, NEW DELHI	SHRI HARI DEV, SCIENTIST E SH. M. RAJA, SCIENTIST D (*Alternate*)	X	X	Y
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	X
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*)	X	Y	Y

10.	GUJARAT ENGINEERING RESEARCH INSTITUTE,(GERI)	SHRI N. R. MAKWANA, JOINT DIRECTOR (IRRIGATION) SHRI V.R.RATHWA, RESEARCH OFFICER (I/C) (*Alternate*)	Y	X	X
11.	HIMACHAL PRADESH POWER CORPORATION LIMITED, SUNDERNAGAR	SHRI ER. R. K. KAUNDAL, GENERAL MANAGER (DESIGNS) SHRI SANJAY KUMAR RANA DEPUTY GENERAL MANAGER (*Alternate*)	X	Y	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	Y	X
14.	INDIAN INSTITUTE OF TECHNOLOGY BHU, VARANASI	SHRI K. K. PANDEY, ASSOCIATE PROFESSOR SHRI PRAMOD SONI, ASSISTANT PROFESSOR (*Alternate*) DR PRABHAT KUMAR SINGH DIKSHIT, PROFESSOR (*Alternate II*)	NR	NR	Y
15.	INDIAN INSTITUTE OF TECHNOLOGY BOMBAY, MUMBAI	SHRI MANNE JANGA REDDY, PROFESSOR	NR	NR	Y
16.	INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI, GUWAHATI	SHRI SUBASHISA DUTTA, PROFESSOR (HAG) SHRI MIHIR KUMAR PURKAI, PROFERSSOR	NR	NR	Y
17.	INDIAN INSTITUTE OF TECHNOLOGY, JODHPUR	PROF P. K. TEWARI	X	Y	Y
18.	INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR, KHARAGPUR	DR MANISH PANDEY, ASSISTANT PROFESSOR	NR	NR	Y
19.	INDIAN INSTITUTE OF TECHNOLOGY KANPUR	PROF. ABHAY KARANDIKAR PROF. ASHU JAIN (*Alternate*)	X	X	X
20.	INDIAN INSTITUTE OF TECHNOLOGY, MANDI	DR. DEEPAK SWAMI, ASSISTANT PROFESSOR	X	Y	Y
21.	INDIAN INSTITUTE OF TECHNOLOGY ROORKEE	PROF. ZULFEQUAR AHMAD, CED PROF. M K SINGHAL, HRED (*Alternate*)	Y	Y	X
22.	IRRIGATION RESEARCH INSTITUTE, ROORKEE	SHRI DINESH CHANDRA, C.E. SHRI NAVEEN SINGHAL, SUPERINTENDING ENGINEER (*Alternate*)	X	Y	X

23.	LARSEN & TOUBRO LIMITED, FARIDABAD	SHRI SATYAJEET SINHA, ENGINEERING MANAGER (CIVIL)	Y	Y	X
24.	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)	Y	Y	Y
25.	NORTH EASTERN ELECTRIC POWER CORPORATION LIMITED, SHILLONG	SHRI B. KALITA, DEPUTY GENERAL MANAGER	X	Y	Y
26.	NTPC LTD., NOIDA	SHRI NAVEEN KUMAR JAIN SHRI NIRAJ KUMAR (Alternate)	X	X	X
27.	PES ENGINEERS PVT. LIMITED	SHRI S.V.S.S. RAJU, VP (DESIGNS) DR. V. SURYA ANANTPANTULA, GM (DESIGNS) (Alternate)	Y	Y	Y
28.	SJVN LTD., NEW SHIMLA	SHRI RAKESH SEHGAL SHRI REVATI RAMAN (Alternate)	Y	Y	Y
29.	SNC LAVALIN, NEW DELHI	SHRI ARUN MEHTA PRACTICE MANAGER, WATERPOWER & DAMS SHRI JAIGANESH SATHYAMURTHY, ASSOCIATE PRINCIPAL ENGINEER	Y	Y	X
30.	THDC INDIA LTD, RISHIKESH	SHRI ATUL JAIN SHRI MAYANK KUMAR (Alternate) SHRI ASHISH KUMAR (Alternate)	Y	Y	X
31.	WATER RESOURCES DEPARTMENT (BODHI) MADHYA PRADESH	SHRI G. P. SONI SHRI DEEPAK SATPUTE (Alternate)	X	X	X
32.	WATER RESOURCES DEPARTMENT, MAHARASHTRA	SUPERINTENDING ENGINEER, LIFT IRRIGATION SCHEME CIRCLE EXECUTIVE ENGINEER, LIFT IRRIGATION SCHEME DIVISION-1 (Alternate)	X	X	X
33.	IN PERSONAL CAPACITY	DR. NAYAN SHARMA	Y	Y	Y
34.	IN PERSONAL CAPACITY	PROF. GOPAL DAS SINGHAL	X	Y	Y

ANNEX 2
(*Clause 3.1*)

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
1.	IS 4410 Part 20 : 1983	Glossary of terms relating to river valleyprojects Part 20 tunnels
2.	IS 4880 Part 1 : 1987	Code of practice for design of tunnels conveying water Part 1 general designFirst Revision
3.	IS 4880 Part 2 : 1976	Code of practice for design of tunnels conveying water Part 2 geometric designFirst revision
4.	IS 4880 Part 3 : 1976	Code of practice for design of tunnels conveying water Part 3 hydraulic designFirst Revision
5.	IS 4880 Part 4 : 1971	Code of practice for design in tunnels conveying water Part 4 structural designof concrete lining in rock
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
7.	IS 4880 Part 6 : 1971	Code of practice for design of tunnels conveying water Part 6 tunnel supports
8.	IS 4880 Part 7: 2014	Code of practice for design of tunnels conveying water Part 7 structural design ofsteel lining First Revision
9.	IS 5330 : 1984	Criteria for design of anchor blocks for penstocks with expansion joints First Revision
10.	IS 5878 Part 1 : 1971	Code of practice for construction of tunnels conveying water Part 1 precisionsurvey and setting out
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
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
13.	IS 5878 Part 2 Sec 3 : 1971	Code of practice for construction of tunnels conveying water Part 2 underground excavation in rock section 3tunnelling method for steeply inclined tunnels shafts and underground power houses
14.	IS 5878 Part 3 : 1972	Code of practice for construction of tunnels Part 3 underground excavation insoft strata
15.	IS 5878 Part 4 : 1971	Code of practice for construction of tunnels conveying water Part 4 tunnelsupports

16.	IS 5878 Part 5 : 1976	Code of practice for construction of tunnels conveying water Part 5 concrete lining First Revision
17.	IS 5878 Part 6 : 1975	Code of practice for construction of tunnels Part 6 steel lining
18.	IS 5878 Part 7 : 1972	Code of practice for construction of tunnels conveying water Part 7 grouting
19.	IS 7357 : 1974	Code of practice for structural design of surge tanks
20.	IS 7396 Part 1 : 1985	Criteria for hydraulic design of surge tanks Part 1 simple restricted orifice and differential surge tanks First Revision
21.	IS 7396 Part 2 : 1985	Criteria for hydraulic design of surge tanks Part 2 tail race surge tanks First Revision
22.	IS 7396 Part 3 : 1990	Criteria for hydraulic design of surge tanks Part 3 special surge tanks
23.	IS 7396 Part 4 : 1983	Criteria for hydraulic design of surge tanks Part 4 multiple surge tanks
24.	IS 7563 : 1986	Code of practice for structural design of cut and cover concrete conduits First Revision
25.	IS 7916 : 1992	Open power channels - Code of practice First Revision
26.	IS 9761 : 1995	Hydropower intakes - Criteria for Hydraulic Design First Revision
27.	IS 11105 : 2004	Design and Construction of Tunnel Plugs - Code of Practice
28.	IS 11388 : 2012	Recommendations for design of trash racks for intakes Second Revision
29.	IS 11625 : 1986	Criteria for hydraulic design of penstocks
30.	IS 11639 Part 1 : 1986	Criteria for structure design of penstocks Part 1 surface penstocks
31.	IS 11639 Part 2 : 1995	Structural design of penstocks - Criteria Part 2 buried/embedded penstocks in rock
32.	IS 11639 Part 3 : 1996	Structural design of penstock - Criteria Part 3 specials for penstocks
33.	IS 12633 : 1989	First filling and emptying of pressure tunnels — Guidelines
34.	IS 12967 Part 1 : 1990	Analysis of hydraulic transients in hydro - Electric and pumping plants - Code of practice Part 1 criteria for analysis
35.	IS 13495 : 1992	Design of sediment excluders - Guidelines
36.	IS 15310 : 2003	Hydraulic design of pump sumps and intakes - Guidelines
37.	IS 16173 : 2014	Criteria for hydraulic design of sediment removal devices for hydro power projects First Revision

ANNEX 3

(Item 5.1)

Inputs received from Dr. K. K. Pandey, Department of Civil Engineering IIT(BHU), Varanasi-221005

The following observations regarding the design of lining of water conveyance tunnel under pressure.

1. *Design Guidelines for non-circular sections*
2. *Recommendations on limit of crack*

Please find below my observations:

1. Design of lining for non-circular Tunnels

Para 8.4.7 and 8.5.2 of IS 4880(Part IV) recommends the use of numerical methods to determine the stress distributions for non-circular lining.
However, a study of physical model for stress distribution in non-circular tunnels should be done to create the additional data in the form similar to Table Nos. 3-7 of Appendix-C for the loading conditions as given in Annexure-B (and also Annexure-A, if required) of this code. These along with available field data may be used to develop a design criterion for non-circular tunnel lining which may be useful for practicing engineers.
Therefore, BIS may float a project for physical model study for designing non-circular (e.g. Horse Shoe) tunnel sections under the specified loading condition as for circular section mentioned in this code.

2. Recommendations on Crack-limit

Para 8.5.1 of IS 4880 (Part IV) clearly mentions the provisions to limit the crack. These provisions may be suitably applied to the D-3.2, D-3.3 and D-3.5 cases of Annexure-D of this code for circular tunnels and similar cases for non-circular tunnels if stress distributions are known.
However, para 1&2 of part C (Chapter-3) of ASCE/EPRI guidelines entitled "*Civil Engineering Guidelines for Planning and Designing Hydroelectric Developments" Vol 2,* may be referred on crack criteria for design of lining in circular water conveying tunnels.

ANNEX 4

(Item 5.2)

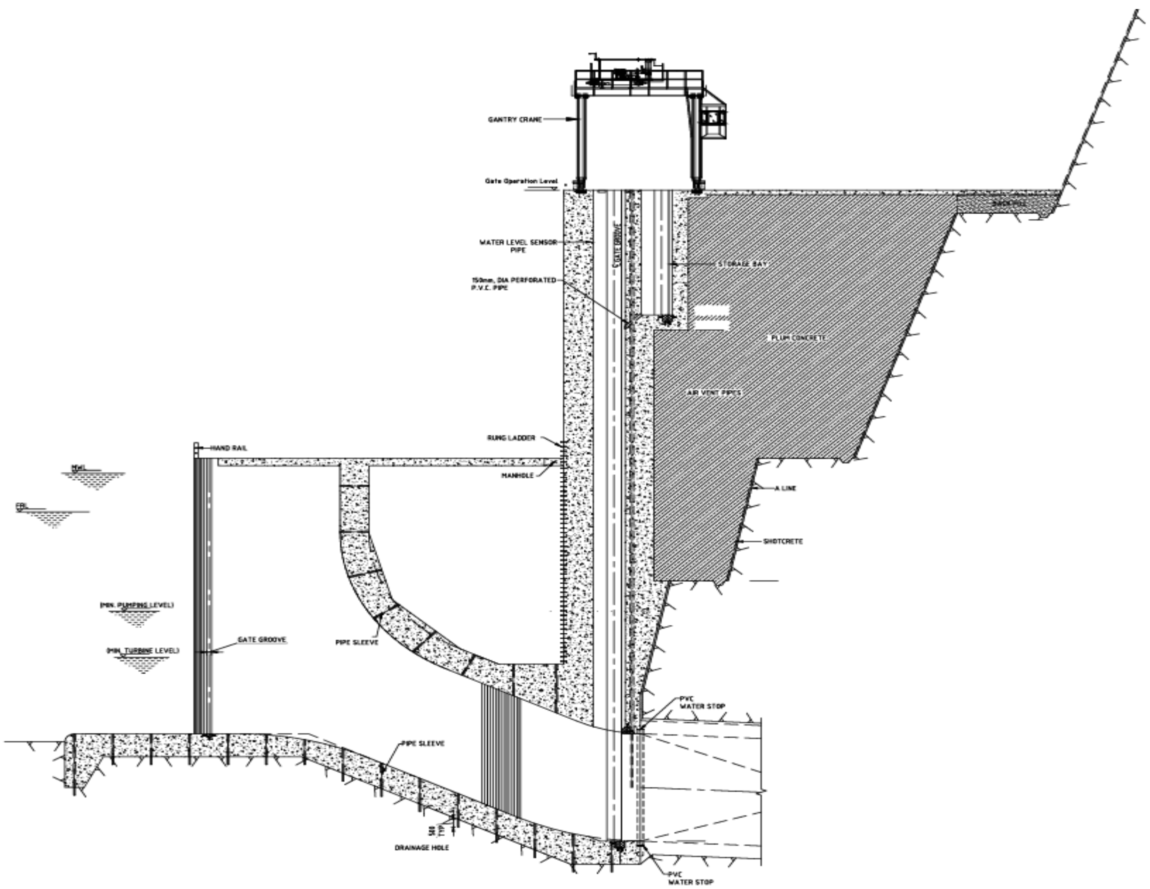


Figure provided by THDC showing the layout of Intake for Pumped Storage scheme (in replacement of figure XX in the P-draft)

ANNEX 5

(Item 7.1 & 7.2)

Title: 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/ 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 isdone 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:

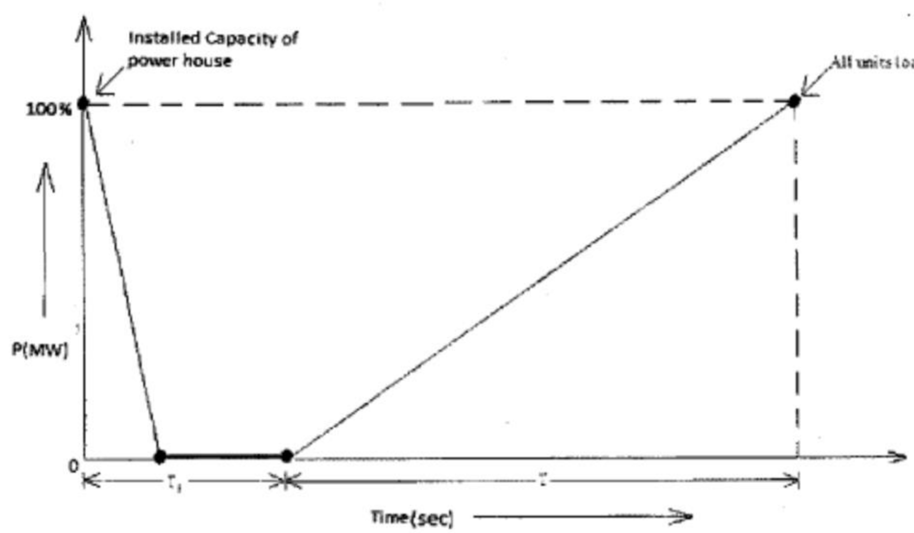


Figure-B-1: Simultaneous loading of units

The total time of needle/guide vane opening from speed no-load condition to full load 'T' shallnot 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 onethrough 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:

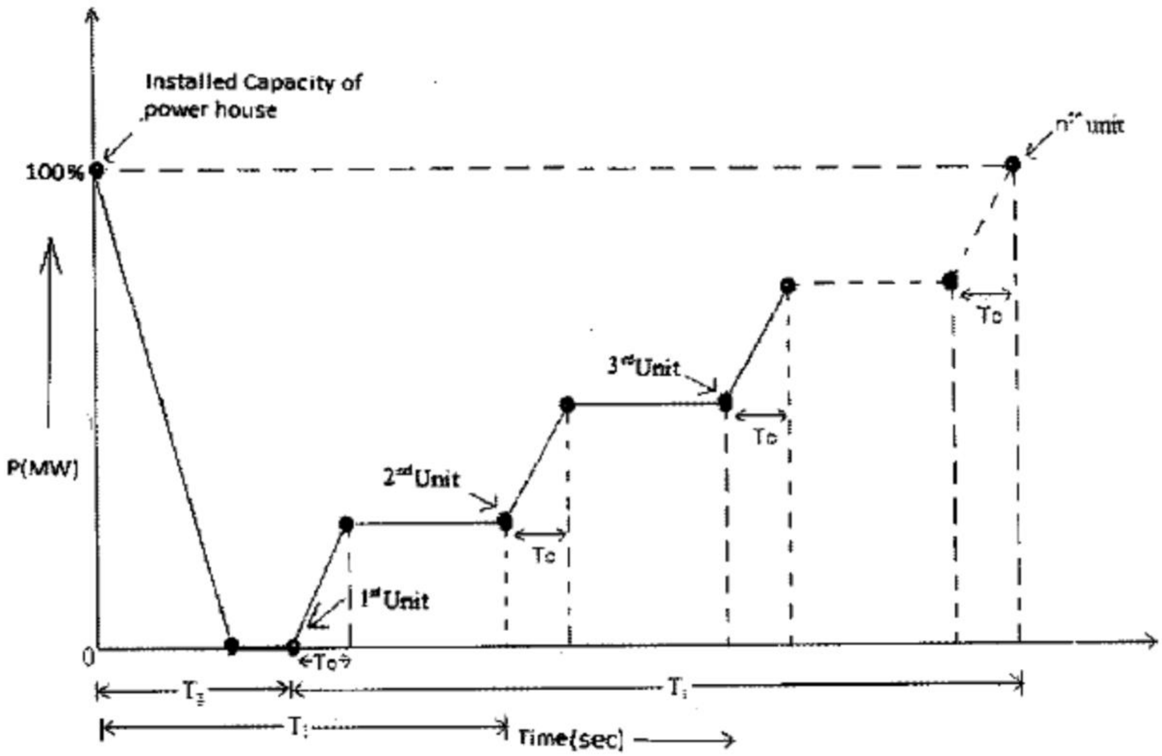


Figure-B-2: Ramping up of load for Units one by one

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 T_1 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:

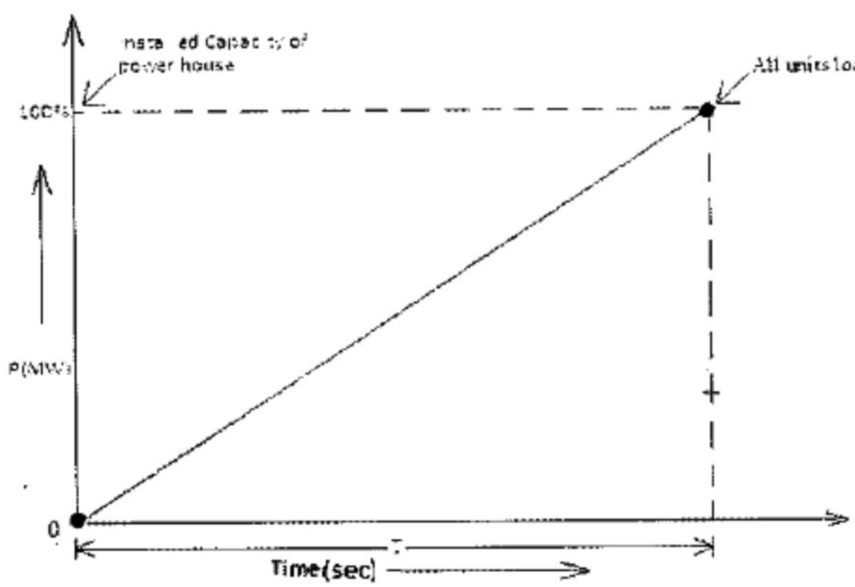


Figure-B-3: Ramping up of load for all the Units together

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 <u>Ramping up of load for units one by one:</u> 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.

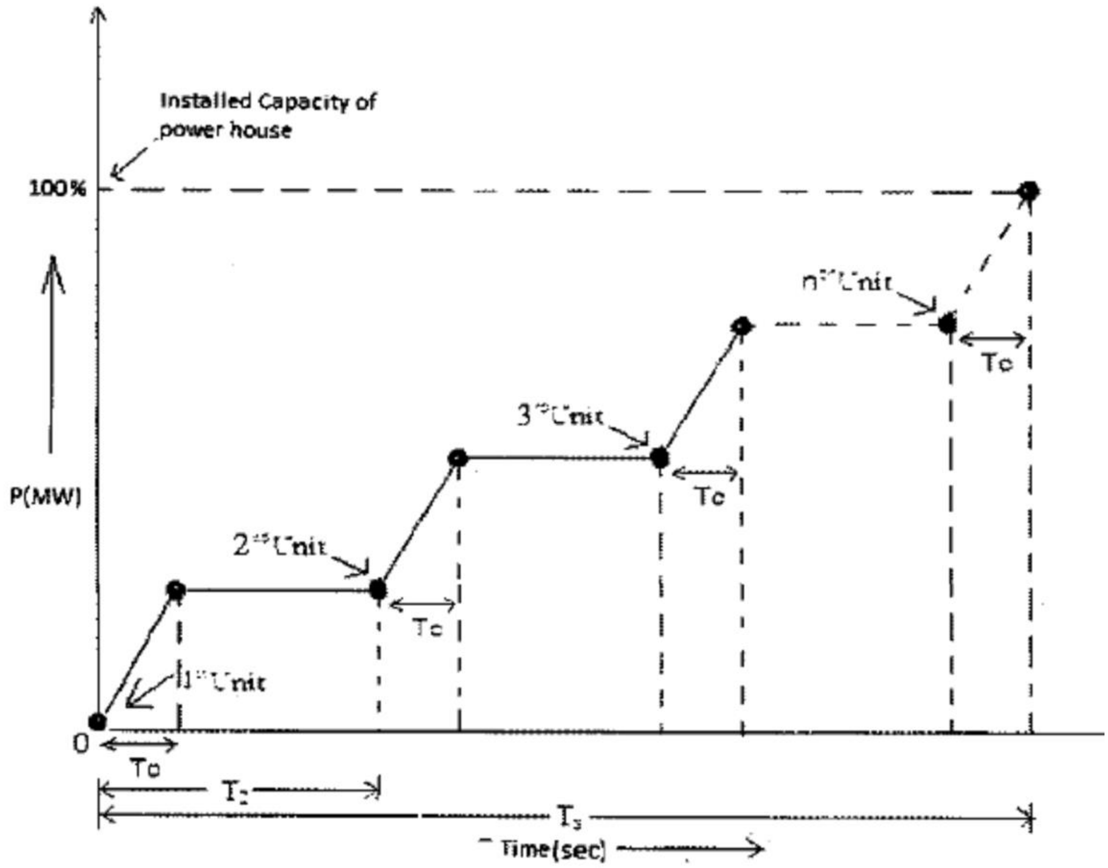


Figure-B-4: Ramping up of load for Units one by one

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 T2 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 toloading of 2nd unit from total time and dividing that by number of remaining units.

Note: T2 is the time of half oscillation in the simple surge shaft for frictionless system. Hence, it is advisable to obtain correct value of T2 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

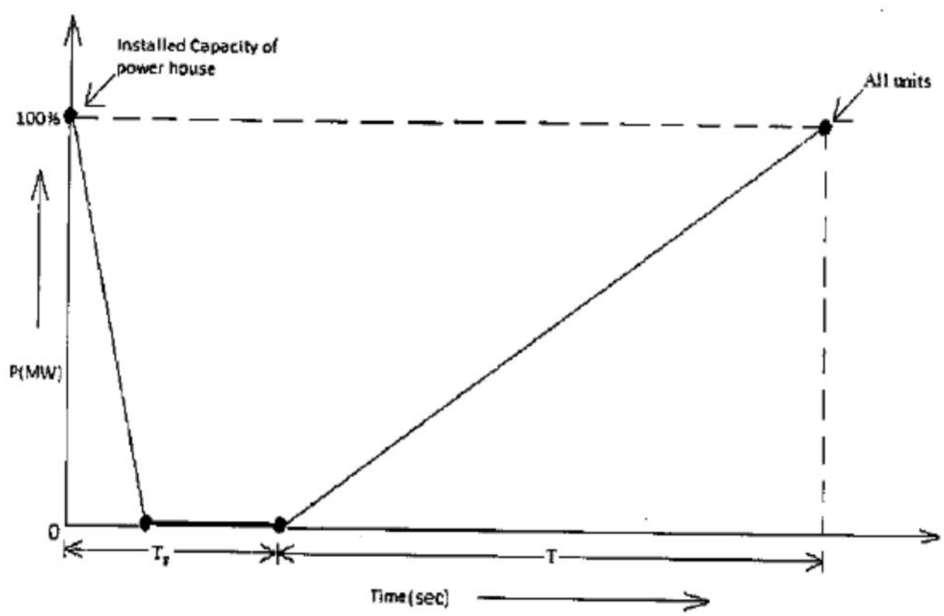
Length of HRT = 9000m

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.

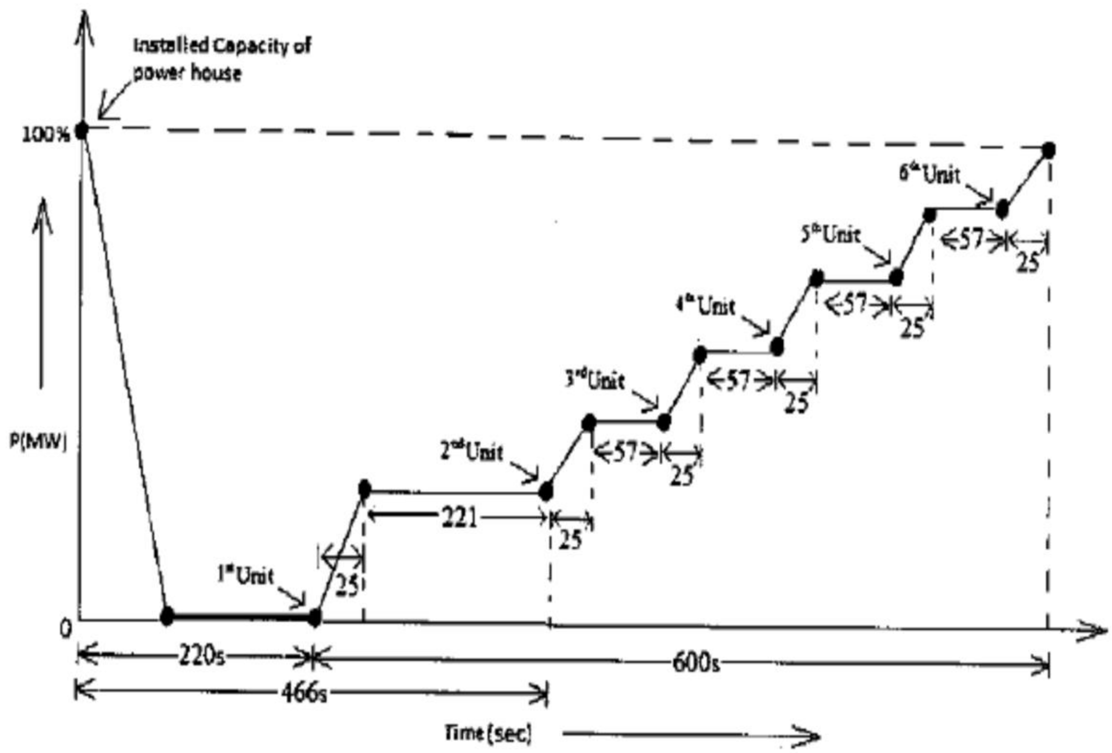
b) Loading of units one by one

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

= 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>

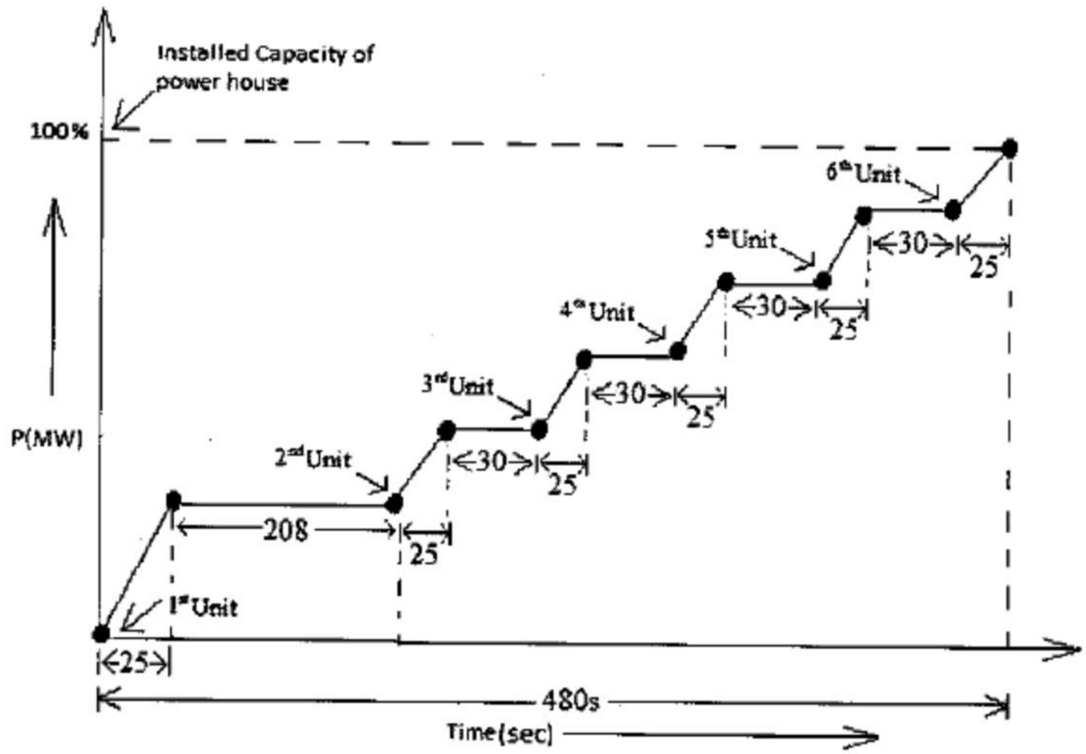
a) Ramping up all units together at the rate of 2.5 MW/sec. (say) T = 1200/2.5 = 480 sec.
b) Loading of units one by one T_1 = 233 sec.

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
25
208
25
30
25
30
25
30
25
30
25
30
25
480s
Time(sec)

ANNEX 6

(Item 7.1)

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.**

ANNEX 7

(Item 8.1)

Comments received from HPPCL on IS 11639 Part 2:

Sl. No.	**Name of the Organization**	**Clause**	**Type of Comment General/ Technical/ Editorial**	**Comments (Justification For Change)**
1.	HPPCL	Clause 4.2.4 11639 part (2):1995	Technical	Para (c) states as, "Emergency condition includes partial gate closure in critical time of penstock (2L/a seconds) at maximum rate, and the cushioning stroke being inoperative in one unit". The above mentioned condition seems in order for considering of water hammer for single unit arrangement, however for arrangement having more than one units (in case of manifold) criteria for considering water hammer is not defined. However, 12967 Part (1) :1990 states under clause 6.1.2 (b) reaction turbine (iii) The water hammer shall be computed for maximum reservoir head condition for final part gate closure to zero gate position on one unit at the maximum governor rate of 2L/a seconds. Moreover, when closure of one unit is considered no emergency condition of operation arises as the velocity of flow decreases considerably. Further, in IS : 4880 part (4):1971 (re-affirmed in 1995) the number of units is not mentioned.

2.			Technical	What percentage for partial gate opening shall be considered for computing water hammer under emergency condition.
3.	HPPCL	Clause 4.2.4 11639 part (2): 1995	Technical	The para reads "Emergency condition includes partial gate closure in critical time of penstock (2L/a seconds) at maximum rate, and the cushioning stroke being inoperative in one unit". The above-mentioned condition seems to be in order for computing water hammer for single penstock feeding single unit. However, for arrangement having main penstock feeding more than one unit (in case of manifold/header) criterion for computing water hammer value is not documented/ well defined. Moreover, it has been linked with partial gate closure in critical time of penstock in IS 11639 part 2. The same however is linked with final part gate closure to zero gate closure in IS 12967 Part 1 under clause 6.1.2 (b). The moot question is how to compute partial gate closure in critical time of penstock. Furthermore, what inferences the designer must draw from the final part gate closure to zero gate closure in critical time of penstock and how to compute it. There is no mention of number of units to be considered for computing water hammer value in critical time of penstock is IS 4880- Part (4): 1971. All these codes need to be integrated in order to avoid any controversy. As computation of water hammer value in critical time of penstock is

				linked with velocity of flow destroyed, in this critical time especially in penstocks which have this critical time of less than 1.0 sec.
4.	HPPCL	-do-	-do-	In case of Francis turbine, the condition of instantaneous closure of guide vanes due to malfunctioning of governor can never be realized. Any malfunctioning of control systems would, instead of making these close instantaneously, would however, render the guide vanes in open position which shall mean that there is no any abnormal rise in water hammer value as envisaged during emergency condition.