

2X800 MW NTPC DARLIPALI STPP-SG

VOLUME –IIB

**TECHNICAL SPECIFICATION
FOR
PLATE HEAT EXCHANGERS**

Specification No. : PE-TS-403-179-N001 (Rev 0)



**BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA-201301**



TITLE :
**TECHNICAL SPECIFICATION FOR
PLATE HEAT EXCHANGERS
PREAMBLE**

SPEC. NO.: PE-TS-403-179-N001

VOLUME II B

SECTION

REV. NO. 0

DATE 09.10.2014

The tender document contains three (3) volumes. The bidder shall meet the requirements of all the three volumes.

1.1 Volume -I CONDITIONS OF CONTRACT

This consists of four parts as below:

Volume - I A: This part contains instructions to bidders for making bids to BHEL.

Volume - I B: This part contains general commercial conditions of the tender and includes provision that vendor shall be responsible for the quality of item supplied by their sub-vendors.

Volume - I C: This part contains special conditions of contract.

Volume - I D: This part contains commercial conditions for erection and commissioning site work, as applicable.

1.2 Volume - II TECHNICAL SPECIFICATIONS Technical requirements are stipulated in Volume II which comprises of :

Volume - II A: General Technical Conditions

Volume - II B: Technical specification including drawings, if any.

1.2.1 Volume - II B : This volume is sub-divided into following sections:

Section – A: This section outlines the scope of enquiry.

Section – B: This section provides “Project Information”

Section – C: This section indicates technical requirements specific to the contract, not covered in Section-D.

Section – D: This section comprises of technical specifications of equipment's complete with data sheet A, B & C.

Data sheet-A specifies data and other requirements pertaining to the equipment.

Data sheet - B specifies data to be filled by the bidder (Data Sheet B is contained in Volume - III)

Data sheet - C indicates data documents to be furnished after the award of contract as per agreed schedule by the vendor (as applicable).

1.2.2 Volume - III: TECHNICAL SCHEDULES - This volume contains technical schedules and Data Sheets - B, which are to be duly filled by the bidder and the same shall be furnished with the technical bid as per instructions given in Volume-III.

2.0 The requirements mentioned in Section C/Data Sheets-A of Section-D shall prevail and govern in case of conflict between the same and the corresponding requirements mentioned in the descriptive portion in Section -D



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**TECHNICAL SPECIFICATION FOR
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VOLUME II B

SECTION A

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SHEET 1 OF 1

1.00.00 **SCOPE**

This enquiry covers the design, manufacture, assembly, inspection and testing at manufacturer's and/ or his sub-contractors works, painting, proper packing & delivery of the item namely **PLATE HEAT EXCHANGERS** complete with all accessories, commissioning spares (if any), Mandatory spares, counter flanges with nuts, bolts, gaskets and coatings (wherever necessary), including special tools & tackles (if any), including site PG test as mentioned in this specification for the 2x800 MW NTPC DARLIPALI-SG

2.00.00 **GENERAL TECHNICAL INSTRUCTIONS**

2.01.00 It is not the intent to specify herein all the details of design and manufacture. However the equipment shall conform in all respects to high standards of design, engineering and workmanship, and shall be capable of performing the required duties in a manner acceptable to Engineer/ Owner, who will interpret the meaning of drawing and specifications, and shall be entitled to reject any component or material, which in his judgement is not in full accordance herewith.

2.02.00 The omission of specific reference to any component/ accessories necessary for the proper performance of Plate Heat Exchangers shall not relieve the bidder of the responsibility of providing such facilities to complete the supply of heat exchangers at quoted prices.

2.03.00 Design/ drawings/ data sheets etc. shall be subject to approval of BHEL as per specification, in the event of order.

2.04.00 BHEL's / customer's representative shall be given access to the shop in which the equipment are being manufactured or tested and all test records shall be made available to him.

2.05.00 The equipment covered under this specification shall not be despatched unless the same have been finally inspected, accepted and shipping release issued by BHEL.



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PLATE HEAT EXCHANGERS

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VOLUME II B


SECTION C


REV. NO. 0

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SECTION B
PROJECT INFORMATION

CLAUSE NO.	PROJECT INFORMATION			
1.00.00	<p>BACKGROUND</p> <p>Darlipali Integrated Thermal Power Project has been conceived as a 3200 MW capacity coal based power plant, for which about 3000 acres of land has been identified for plant, township and ash disposal areas. Water Resources Department, Govt. of Orissa vides letter dated 06.01.2010 accorded In-principle availability of 160 cusec water from Hirakud reservoir. First Stage Site Clearance is obtained from Ministry of Environment and Forests (MOEF). Presently, Darlipali Integrated TPP, Stage-I (2x800 MW) is proposed to be commissioned as an inter regional power project during XII Plan period for the benefit of States of Eastern Region and adjoining Regions.</p>			
1.01.00	<p>LOCATION AND APPROACH</p> <p>The site is located north of Raigarh-Jharsuguda NH-200 and is approachable from Gandhi Chowk (near Brajarajnar) through 15 Kms long single lane village road. Nearest major town Jharsuguda is at a distance of about 25 Kms. Nearest rail head is Brajarajnar Railway Station (20 Kms) on SEC Rly.(BG) main line.</p> <p>Darlipali project site is about 330 kms from Bhubaneshwar Airport in Orissa and about 300 kms from Raipur Airport in Chhattisgarh State.</p> <p>Vicinity Plan is enclosed as Annexure – I</p>			
1.02.00	<p>LAND</p> <p>About 3000 acres of land (mostly private, rain fed agricultural, yielding single crop) is available. In-principle availability of land received from District Magistrate & Collector, Sundargarh, Govt. of Orissa vide letter dated 22.11.2005.</p> <p>Land Requirement</p> <p>The Main Plant, Township, Ash disposal, Railway siding and reservoir etc. for this stage of project shall be accommodated in 2700 Acres.</p>			
1.03.00	<p>WATER</p> <p>Hirakud reservoir on Mahanadi river (approx. 30 Kms away) is the source of water for the project.</p> <p>Water Resources Department, Govt. of Orissa vides letter dated 06.01.2010 accorded In-principle availability of 160 cusec water from Hirakud reservoir for the proposed power plant at Darlipali.</p>			
1.04.00	<p>Railway Siding</p> <p>Employer intends to construct the railway siding to the project site for bringing the equipment/ material and coal. However the same may not be available to the bidder for his use to transport equipment and material.</p> <p>Bidder may visit the site and acquaint themselves with the facilities available.</p>			
1.05.00	<p>COAL AVAILABILITY AND TRANSPORTATION</p> <p>Coal requirement for 1600 MW project is estimated as 9.40 Million Tonne Per Annum (MTPA) considering average GCV of 3100 kcal/kg. The envisaged mode of coal transportation from the coal mines to the power plant is by MGR through BOBR wagons and also through Indian Railways rakes in BOBR/BOXN wagons. Requirement of coal for ultimate</p>			
<p>DARLIPALI SUPER THERMAL POWER PROJECT STAGE-I (2X800 MW) STEAM GENERATOR PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO. : CS-9549-102-2</p>	<p>PART-A SUB SECTION-II PROJECT INFORMATION</p>	<p>PAGE 1 OF 17</p>	

CLAUSE NO.	PROJECT INFORMATION			
	<p>capacity of project will be met from Dulanga (7.0 MTPA) and 12.5 MTPA from Pakri Barwadih captive coal blocks allotted to NTPC.</p>			
1.06.00	<p>Coal Quality Parameters / Fuel Oil Characteristics</p>			
	<p>The coal quality parameters and Fuel oil Characteristics are attached at SUB-SECTION-V, PART-A.</p>			
1.07.00	<p>Capacity</p>			
	<p>Stage-I : 2x800 MW Present proposal</p>			
1.08.00	<p>Construction Power</p>			
	<p>The construction power requirement of the project is envisaged approximately 5-6 MVA. The same is proposed to be availed at 33kV voltage level from Brajrjnagar of WESCO located at approximately 20 kms from plant. Necessary substation and 11kV ring main/ LT substation shall be provided for the power plant area as required.</p>			
1.09.00	<p>Metrological Data</p>			
	<p>The metrological data from nearest observatory is placed at Annexure-II.</p>			
1.10.00	<p>Plant Water Scheme</p>			
	<p>The Plant water scheme is described below.</p>			
1.10.01	<p>Condenser Cooling (CW) Water System</p>			
	<p>It is proposed to provide recirculating type CW system with induced draft type cooling towers. For the recirculating type CW system it is proposed to supply clarified water as make up. Clarified water shall be pumped to the cold water channel of CW system. CW system shall be operated at a C.O.C of about 3. The expected circulating water analysis is given in this sub-section. CW blow down shall be drawn from the discharge of CW pumps and the same shall be led to a Service water Tank. For carrying circulating water from CW pump house to TG-area and from TG area to cooling tower, steel lined concrete encased duct would be provided. For interconnecting CW duct with CW pump, condenser and cooling towers, steel pipes would be used. Cooled water from cooling tower will be led to CW pump house through the cold water channel by gravity.</p>			
1.10.02	<p>Equipment Cooling Water (ECW) System (Unit Auxiliaries)</p>			
	<p>The plant auxiliaries of Steam Generator and Turbine Generator shall be cooled by Demineralised (DM) water in a closed circuit. The primary circuit DM water shall be cooled through plate type heat exchangers by Clarified water. The hot secondary circuit cooling water shall be cooled in the cooling towers and shall be returned back to the system. It is proposed to provide independent primary cooling water circuit for Steam Generator & auxiliaries and TG & its auxiliaries.</p>			
1.10.03	<p>Station Auxiliaries Cooling Water System</p>			
	<p>The station auxiliaries such as Air compressors, Compressors of ash handling plant, Cooling water circuit of Air Conditioning system, compressor of mill reject system etc. shall be cooled by clarified water pumped by station auxiliary cooling water system The hot station auxiliary cooling water shall be cooled in the auxiliary cooling towers and returned back to the system.</p>			
<p>DARLIPALI SUPER THERMAL POWER PROJECT STAGE-I (2X800 MW) STEAM GENERATOR PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO. : CS-9549-102-2</p>	<p>PART-A SUB SECTION-II PROJECT INFORMATION</p>	<p>PAGE 2 OF 17</p>	

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1.10.04	<p>Ash Water System</p> <p>a) It is proposed to operate ash water system in a closed circuit. The ash water from the ash dyke shall be recirculated . Make up to the ash water system (to compensate for the ash water system evaporation loss in ash dyke) shall be supplied from excess CW blow down water (Service water) and raw water supply from water source of the plant.</p>			
1.10.05	<p>Other Miscellaneous Water Systems</p> <p>a) CW system blow down water shall be used for the plant service water requirement, ash slurry pumps sealing, sealing of Vacuum pumps (if applicable) of Ash Handling plant, make-up to fire water storage tanks and cooling water requirement of hydrogen generation plant. The balance CW blowdown ,service (wash water) water collected from various areas shall be treated using oil water separators, tube settlers, coal settling pits etc. as per requirement and treated water from liquid effluent treatment plant shall be recycled back to the service water system for re-use. The excess service water shall be led to central monitoring basin for disposal.</p> <p>b) Separate water Pre-treatment plants are proposed for Circulating Water (PT-CW) system and Demineralisation Plant (PT-DM) plant</p> <p>c) The drinking water requirement of the plant and colony shall be provided from the above mentioned Water (PT-CW) pretreatment plant.</p> <p>d) Steam Cycle make-up water, makeup to the primary circuit of ECW (unit auxiliaries) system, boiler fill water and makeup to the hydrogen generation plant shall be provided from Demineralising plant.</p> <p>e) The quality of cooling water & DM water is given in this sub-section.</p>			
1.11.00	<p>Criteria for Earthquake Resistant Design of Structures and Equipment</p> <p>All power plant structures and equipment, including plant auxiliary structures and equipment shall be designed for seismic forces as given in this sub-section as Annexure-V.</p>			
1.12.00	<p>Criteria for Wind Resistant Design of Structures and Equipment</p> <p>All structures and equipment of the power plant, including plant auxiliary structures and equipment, shall be designed for wind forces as given as given in this sub-section as Annexure-VI.</p>			
<p>DARLIPALI SUPER THERMAL POWER PROJECT STAGE-I (2X800 MW) STEAM GENERATOR PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO. : CS-9549-102-2</p>		<p>PART-A SUB SECTION-II PROJECT INFORMATION</p>	<p>PAGE 3 OF 17</p>

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PROJECT INFORMATION



ANNEXURE-I



DARLIPALI SUPER THERMAL POWER PROJECT
STAGE-I (2X800 MW)
STEAM GENERATOR PACKAGE

TECHNICAL SPECIFICATION
SECTION-VI
BID DOC. NO. : CS-9549-102-2

PART-A
SUB SECTION-II
ANNEXURE-I

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Annexure-II

जलवायवी सारणी
CLIMATOLOGICAL TABLE

1951 से 1980 तक के अवधि पर आधारित
BASED ON OBSERVATIONS FROM 1951 TO 1980

स्थान : झांझार
STATION : Jharsuguda

अक्षांश : 21°55' N LONG 84°05' E

उचाई : 230 METRES
HEIGHT ABOVE M.S.L.

वर्षा : वर्षा

MONTH	DRY BULB			WET BULB			WIND SPEED			RAINFALL						
	दि.से. °C	दि.से. °C	दि.से. °C	दि.से. °C	दि.से. °C	दि.से. °C	दि.से. kmph	दि.से. kmph	दि.से. mm	दि.से. mm	दि.से. mm	दि.से. mm				
JAN	9.0	12.0	7.5	6.0	10	1976	67	12.8	4.3	12.5	1.1	61.4	0.0	36.4	1.1	1968
FEB	9.8	14.7	9.9	7.2	1967	57	13.2	3.3	18.0	1.3	116.7	0.0	46.7	0.6	1961	
MAR	15.1	19.0	13.9	11.1	1961	44	14.0	2.5	21.0	1.8	97.8	0.0	58.7	2.6	1951	
APR	25.4	30.8	21.4	15.8	1973	41	17.7	2.1	13.8	1.4	58.9	0.0	31.8	1.8	1952	
MAY	32.9	38.9	31.1	22.3	1976	46	22.3	2.5	29.9	2.2	107.8	0.0	63.8	1.4	1963	
JUN	30.2	37.2	28.0	16.3	1978	66	27.4	5.9	228.7	9.6	824.9	42.2	197.9	1.1	1963	
JUL	33.4	40.1	33.4	17.4	1979	54	25.1	6.6	3.5	1956	17.5	770.7	230.8	189.8	0.8	1961
AUG	28.9	34.8	22.3	17.4	1976	86	30.2	7.2	4.3	402.7	17.5	770.7	230.8	189.8	0.8	1961
SEP	26.0	31.0	22.4	16.6	1972	87	30.6	7.2	4.3	428.5	17.3	657.9	212.1	257.8	2.0	1965
OCT	27.2	31.8	22.3	16.7	1968	83	29.9	6.0	3.2	233.1	11.7	714.5	42.5	190.9	0.3	1973
NOV	28.4	31.9	17.0	12.1	1974	75	24.9	3.6	1.5	65.0	4.0	181.5	0.2	110.2	0.9	1962
DEC	21.3	27.6	12.0	8.4	1976	66	17.0	2.1	0.5	4.3	0.4	28.7	0.0	26.8	2.4	1972
ANNUAL MEAN	23.0	27.6	12.0	6.1	1977	57	13.8	2.8	3.4	0.5	22.0	0.0	18.8	0.1	1978	
ANNUAL MEAN	25.1	33.1	20.5	6.0	1980	65	21.1	3.6	1.6	1460.9	68.7	2656.6	901.0	257.8	7.0	1978

DARLIPALI SUPER THERMAL POWER PROJECT
STAGE-I (2X800 MW)
STEAM GENERATOR PACKAGE

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PART-A
SUB SECTION-II
ANNEXURE-II

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Annexure – III

DESIGN CLARIFIED WATER ANALYSIS

S.No	Constituent	As	mg/l
1	Calcium	CaCO ₃	135
2	Magnesium	CaCO ₃	88
3	Sodium	CaCO ₃	40
4	Potassium	CaCO ₃	9
	Total cations	CaCO ₃	272
4	HCO ₃	CaCO ₃	173
5	P-alkalinity	CaCO ₃	0
6	Chloride	CaCO ₃	36
7	Sulphate	CaCO ₃	63
	Total Anions	CaCO ₃	272
8	Silica, Reactive	Si	8
9	Iron (Total)	Fe	0.5
10	pH		7.0- 7.8
11	Turbidity	NTU	10
12	Total Dissolved Solids		210-270
13	Temperature	⁰ C	20 - 35

Note : The C.W system is expected to operate at about 3 Cycles of Concentration. As CW blow down water (Service Water) is tapped from discharge of CW pumps, the water quality of CW Blow down water shall be same as that above.

CLAUSE NO.


PROJECT INFORMATION





Annexure – IV

**ANALYSIS OF DM WATER TO BE USED FOR
MAKE-UP WATER TO CONDENSER**

S.No.	Characteristics		Value
i)	Silica (Max.)	-	0.02 ppm as SiO ₂
ii)	Iron as Fe	-	Nil
iii)	Total hardness	-	Nil
iv)	pH value	-	6.8 to 7.2
v)	Conductivity	-	Not more than 0.1 excluding the effects of free CO ₂

CLAUSE NO.	PROJECT INFORMATION																			
<p>1.01.00</p> <p>1.01.01</p>	<p style="text-align: center;">Annexure - V</p> <p>CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT</p> <p>All structures and equipment shall be designed for seismic forces adopting the site specific seismic information provided in this document and using the other provisions in accordance with IS:1893 (Part 1):2002 and IS:1893 (Part 4):2005. Pending finalisation of Parts 2, 3 and 5 of IS:1893, provisions of part 1 shall be read along with the relevant clauses of IS:1893:1984, for structures other than the buildings and industrial structures including stack-like structures.</p> <p>A site specific seismic study has been conducted for the project site. The peak ground horizontal acceleration for the project site, the site specific acceleration spectral coefficients (in units of gravity acceleration 'g') in the horizontal direction for the various damping values and the multiplying factor (to be used over the spectral coefficients) for evaluating the design acceleration spectra are as given at APPENDIX-A to Annexure-V.</p> <p>Vertical acceleration spectral values shall be taken as 2/3rd of the corresponding horizontal values.</p> <p>The site specific design acceleration spectra shall be used in place of the response acceleration spectra, given at figure-2 in IS:1893 (Part 1) and Annex B of IS:1893 (Part 4). The site specific acceleration spectra along with multiplying factors specified in APPENDIX-A to Annexure-V includes the effect of the seismic environment of the site, the importance factor related to the structures and the response reduction factor. Hence, the design spectra do not require any further consideration of the zone factor (Z), the importance factor (I) and response reduction factor (R) as used in the IS:1893 (Part 1 and Part 4).</p> <p>Damping in Structures</p> <p>The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for:</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 5%;">a)</td> <td style="width: 65%;">Steel structures</td> <td style="width: 10%;">:</td> <td style="width: 20%;">2%</td> </tr> <tr> <td>b)</td> <td>Reinforced Concrete structures</td> <td>:</td> <td>5%</td> </tr> <tr> <td>c)</td> <td>Reinforced Concrete Stacks</td> <td>:</td> <td>3%</td> </tr> <tr> <td>d)</td> <td>Steel stacks</td> <td>:</td> <td>2%</td> </tr> </table>			a)	Steel structures	:	2%	b)	Reinforced Concrete structures	:	5%	c)	Reinforced Concrete Stacks	:	3%	d)	Steel stacks	:	2%	
a)	Steel structures	:	2%																	
b)	Reinforced Concrete structures	:	5%																	
c)	Reinforced Concrete Stacks	:	3%																	
d)	Steel stacks	:	2%																	
<p>LARA SUPER THERMAL POWER PROJECT STAGE-I (2X800 MW) STEAM GENERATOR PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-9548-102-2</p>	<p>PART-A SUB SECTION-II ANNEXURE V</p>	<p>PAGE 9 OF 17</p>																	

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<p>1.01.02</p> <p>1.01.03</p> <p>1.02.00</p>	<div style="text-align: right; border: 1px solid black; padding: 2px; width: fit-content; margin-bottom: 10px;">  </div> <p>Method of Analysis</p> <p>Since most structures in a power plant are irregular in shape and have irregular distribution of mass and stiffness, dynamic analysis for obtaining the design seismic forces shall be carried out using the response spectrum method. The number of vibration modes used in the analysis should be such that the sum total of modal masses of all modes considered is at least 90 percent of the total seismic mass and shall also meet requirements of IS:1893 (Part 1). Modal combination of the peak response quantities shall be performed as per Complete Quadratic Combination (CQC) method or by an acceptable alternative as per IS:1893 (Part 1).</p> <p>In general, seismic analysis shall be performed for the three orthogonal (two principal horizontal and one vertical) components of earthquake motion. The seismic response from the three components shall be combined as specified in IS:1893 (Part 1).</p> <p>For buildings, if the design base shear (V_B) obtained from modal combination is less than the base shear (\bar{V}_B) computed using the approximate fundamental period (T_a) given in IS:1893:Part 1 and using site specific acceleration spectra with appropriate multiplying factor, the response quantities (e.g. member forces, displacements, storey forces, storey shears and base reactions) shall be enhanced in the ratio of \bar{V}_B/ V_B. However, no reduction is permitted if \bar{V}_B is less than V_B.</p> <p>For regular buildings less than 12m in height, design seismic base shear and its distribution to different floor levels along the height of the building may be carried out as specified under clause 7.5, 7.6 & 7.7 of IS:1893 (Part 1) and using site specific design acceleration spectra. The design horizontal acceleration spectrum value (A_h) shall be computed for the fundamental natural period as per clause 7.6 of IS:1893 (Part 1) using site specific spectral acceleration coefficients with appropriate multiplying factor given in APPENDIX-A to Annexure-V. Further, the spectral acceleration coefficient shall get restricted to the peak spectral value if the fundamental natural period of the building falls to the left of the peak in the spectral acceleration curve.</p> <p>Design/Detailing for Ductility for Structures</p> <p>The site specific design acceleration spectra is a reduced spectra and has an in-built allowance for ductility. Structures shall be engineered and detailed in accordance with relevant Indian/International standards to achieve ductility.</p> <p><u>SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT</u></p> <p>For site specific seismic parameters for design of structures and equipment refer Appendix-A to Annexure-V.</p>		
<p>LARA SUPER THERMAL POWER PROJECT STAGE-I (2X800 MW) STEAM GENERATOR PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-9548-102-2</p>	<p>PART-A SUB SECTION-II ANNEXURE V</p>	<p>PAGE 10 OF 17</p>

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	<p style="text-align: center;"><u>APPENDIX-A TO ANNEXURE-V</u></p> <p><u>The various site specific seismic parameters for the project site shall be as follows:</u></p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 5%;">1)</td> <td style="width: 85%;">Peak ground horizontal acceleration (MCE)</td> <td style="width: 10%;"></td> <td style="width: 10%; text-align: right;">: 0.10g</td> </tr> <tr> <td>2)</td> <td>Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') to obtain the design acceleration spectra</td> <td></td> <td></td> </tr> <tr> <td>a)</td> <td>for ordinary moment resisting steel frames designed and detailed as per IS:800</td> <td></td> <td style="text-align: right;">: 0.029</td> </tr> <tr> <td>b)</td> <td>for braced steel frames designed and detailed as per IS:800</td> <td></td> <td style="text-align: right;">: 0.022</td> </tr> <tr> <td>c)</td> <td>For special moment resisting RC frames designed and detailed as per IS:456 and IS:13920</td> <td></td> <td style="text-align: right;">: 0.018</td> </tr> <tr> <td>d)</td> <td>for steel chimney</td> <td></td> <td style="text-align: right;">: 0.044</td> </tr> <tr> <td>e)</td> <td>for design of structures not covered under 2 (a) to 2 (d) above and under 3 below</td> <td></td> <td style="text-align: right;">: 0.029</td> </tr> <tr> <td>3)</td> <td>Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') for design of equipment and structures where inelastic action is not relevant or not permitted</td> <td></td> <td style="text-align: right;">: 0.058</td> </tr> </table> <p>Note: g = Acceleration due to gravity</p> <p>The horizontal seismic acceleration spectral coefficients are furnished in subsequent pages.</p>				1)	Peak ground horizontal acceleration (MCE)		: 0.10g	2)	Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') to obtain the design acceleration spectra			a)	for ordinary moment resisting steel frames designed and detailed as per IS:800		: 0.029	b)	for braced steel frames designed and detailed as per IS:800		: 0.022	c)	For special moment resisting RC frames designed and detailed as per IS:456 and IS:13920		: 0.018	d)	for steel chimney		: 0.044	e)	for design of structures not covered under 2 (a) to 2 (d) above and under 3 below		: 0.029	3)	Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') for design of equipment and structures where inelastic action is not relevant or not permitted		: 0.058
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APPENDIX-A TO ANNEXURE-V

HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS
(In units of 'g')

Time Period (Sec)	Damping Factor (as a percentage of critical damping)		
	2%	3%	5%
0.000	1.000	1.000	1.000
0.030	1.000	1.000	1.000
0.031	1.031	1.026	1.020
0.050	1.618	1.502	1.371
0.060	1.921	1.736	1.534
0.070	2.221	1.963	1.687
0.080	2.519	2.183	1.832
0.086	2.697	2.312	1.915
0.088	2.756	2.355	1.943
0.090	2.815	2.398	1.970
0.095	2.962	2.503	2.036
0.098	3.050	2.566	2.076
0.100	3.109	2.607	2.102
0.103	3.196	2.669	2.141
0.108	3.342	2.772	2.204
0.110	3.401	2.813	2.229
0.112	3.459	2.854	2.254
0.115	3.546	2.914	2.291
0.118	3.633	2.975	2.328
0.121	3.720	3.035	2.364
0.122	3.749	3.055	2.376
0.125	3.836	3.114	2.412
0.127	3.893	3.154	2.436
0.129	3.951	3.193	2.460
0.130	3.980	3.213	2.471
0.132	3.980	3.252	2.495
0.134	3.980	3.291	2.518
0.140	3.980	3.408	2.587
0.141	3.980	3.410	2.598
0.150	3.980	3.410	2.700
0.200	3.980	3.410	2.700
0.250	3.980	3.410	2.700
0.300	3.980	3.410	2.700
0.350	3.980	3.410	2.700
0.400	3.980	3.410	2.700
0.431	3.980	3.410	2.700

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PROJECT INFORMATION



APPENDIX-A TO ANNEXURE-V

HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS
(In units of 'g')

Time Period (Sec)	Damping Factor (as a percentage of critical damping)		
	2%	3%	5%
0.442	3.980	3.410	2.700
0.450	3.980	3.410	2.700
0.474	3.980	3.410	2.700
0.495	3.980	3.410	2.700
0.500	3.980	3.410	2.700
0.517	3.849	3.298	2.611
0.525	3.790	3.248	2.571
0.542	3.672	3.146	2.491
0.550	3.618	3.100	2.455
0.562	3.541	3.034	2.402
0.576	3.455	2.960	2.344
0.588	3.384	2.900	2.296
0.597	3.333	2.856	2.261
0.603	3.300	2.828	2.239
0.609	3.268	2.800	2.217
0.615	3.236	2.772	2.195
0.625	3.184	2.728	2.160
0.640	3.109	2.664	2.109
0.658	3.024	2.591	2.052
0.667	2.984	2.556	2.024
0.690	2.884	2.471	1.957
0.700	2.843	2.436	1.929
0.750	2.653	2.273	1.800
0.755	2.636	2.258	1.788
0.800	2.488	2.131	1.688
0.850	2.341	2.006	1.588
0.900	2.211	1.894	1.500
0.950	2.095	1.795	1.421
1.000	1.990	1.705	1.350
1.050	1.895	1.624	1.286
1.100	1.809	1.550	1.227
1.150	1.730	1.483	1.174
1.200	1.658	1.421	1.125
1.250	1.592	1.364	1.080
1.300	1.531	1.312	1.038
1.350	1.474	1.263	1.000
1.400	1.421	1.218	0.964

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APPENDIX-A TO ANNEXURE-V

HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS
(In units of 'g')

Time Period (Sec)	Damping Factor (as a percentage of critical damping)		
	2%	3%	5%
1.450	1.372	1.176	0.931
1.500	1.327	1.137	0.900
1.550	1.284	1.100	0.871
1.600	1.244	1.066	0.844
1.650	1.206	1.033	0.818
1.700	1.171	1.003	0.794
1.750	1.137	0.974	0.771
1.800	1.106	0.947	0.750
1.850	1.076	0.922	0.730
1.900	1.047	0.897	0.711
1.950	1.021	0.874	0.692
2.000	0.995	0.853	0.675
2.050	0.971	0.832	0.659
2.100	0.948	0.812	0.643
2.150	0.926	0.793	0.628
2.200	0.905	0.775	0.614
2.250	0.884	0.758	0.600
2.300	0.865	0.741	0.587
2.350	0.847	0.726	0.574
2.400	0.829	0.710	0.563
2.450	0.812	0.696	0.551
2.500	0.796	0.682	0.540
2.550	0.780	0.669	0.529
2.600	0.765	0.656	0.519
2.650	0.751	0.643	0.509
2.700	0.737	0.631	0.500
2.750	0.724	0.620	0.491
2.800	0.711	0.609	0.482
2.850	0.698	0.598	0.474
2.900	0.686	0.588	0.466
2.950	0.675	0.578	0.458
3.000	0.663	0.568	0.450
3.050	0.652	0.559	0.443
3.100	0.642	0.550	0.435
3.150	0.632	0.541	0.429
3.200	0.622	0.533	0.422
3.250	0.612	0.525	0.415

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PROJECT INFORMATION




APPENDIX-A TO ANNEXURE-V

HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS
(In units of 'g')

Time Period (Sec)	Damping Factor (as a percentage of critical damping)		
	2%	3%	5%
3.300	0.603	0.517	0.409
3.350	0.594	0.509	0.403
3.400	0.585	0.501	0.397
3.450	0.577	0.494	0.391
3.500	0.569	0.487	0.386
3.550	0.561	0.480	0.380
3.600	0.553	0.474	0.375
3.650	0.545	0.467	0.370
3.700	0.538	0.461	0.365
3.750	0.531	0.455	0.360
3.800	0.524	0.449	0.355
3.850	0.517	0.443	0.351
3.900	0.510	0.437	0.346
3.950	0.504	0.432	0.342
4.000	0.498	0.426	0.338

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<p>1.01.00</p> <p>1.01.01</p>	<p style="text-align: center;"><u>ANNEXURE-VI</u></p> <p><u>CRITERIA FOR WIND RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT</u></p> <p>All structures shall be designed for wind forces in accordance with IS:875 (Part-3) and as specified in this document. See APPENDIX – B TO ANNEXURE-VI for site specific information.</p> <p>Along wind forces shall generally be computed by the Peak (i.e. 3 second gust) Wind Speed method as defined in the standard.</p> <p>Along wind forces on slender and wind sensitive structures and structural elements shall also be computed, for dynamic effects, using the Gust Factor or Gust Effectiveness Factor Method as defined in the standard. The structures shall be designed for the higher of the forces obtained from Gust Factor method and the Peak Wind Speed method.</p> <p>Analysis for dynamic effects of wind must be undertaken for any structure which has a height to minimum lateral dimension ratio greater than “5” and/or if the fundamental frequency of the structure is less than 1 Hz.</p> <p>Susceptibility of structures to across-wind forces, galloping, flutter, ovaling etc. should be examined and designed/detailed accordingly following the recommendations of IS:875(Part-3) and other relevant Indian standards.</p> <p>It should be estimated if size and relative position of other structures are likely to enhance the wind loading on the structure under consideration. Enhancement factor, if necessary, shall suitably be estimated and applied to the wind loading to account for the interference effects.</p> <p>Damping in Structures</p> <p>The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for:</p> <table border="0" style="width: 100%;"> <tr> <td style="width: 60%;">a) Welded steel structures</td> <td style="width: 5%; text-align: center;">:</td> <td style="width: 35%;">1.0%</td> </tr> <tr> <td>b) Bolted steel structures</td> <td style="text-align: center;">:</td> <td>2.0%</td> </tr> <tr> <td>c) Reinforced concrete structures</td> <td style="text-align: center;">:</td> <td>1.6%</td> </tr> <tr> <td>d) Steel stacks</td> <td style="text-align: center;">:</td> <td>As per IS:6533 & CICIND Model Code whichever is more critical.</td> </tr> </table>			a) Welded steel structures	:	1.0%	b) Bolted steel structures	:	2.0%	c) Reinforced concrete structures	:	1.6%	d) Steel stacks	:	As per IS:6533 & CICIND Model Code whichever is more critical.	
a) Welded steel structures	:	1.0%														
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c) Reinforced concrete structures	:	1.6%														
d) Steel stacks	:	As per IS:6533 & CICIND Model Code whichever is more critical.														
<p>DARLIPALI SUPER THERMAL POWER PROJECT STAGE-I (2X800 MW) STEAM GENERATOR PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO. : CS-9549-102-2</p>	<p>PART-A SUB SECTION-II ANNEXURE-VI</p>	<p>PAGE 16 OF 17</p>													

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	<p style="text-align: center;"><u>APPENDIX-I TO ANNEXURE-VI</u></p> <p><u>SITE SPECIFIC DESIGN PARAMETERS</u></p> <p>The various design parameters, as defined in IS: 875 (Part-3), to be adopted for the project site shall be as follows:</p> <p>a) The basic wind speed “Vb” at ten metres above the mean ground level : 39 metres/second</p> <p>b) The risk coefficient “K1” : 1.06</p> <p>c) Category of terrain : Category-2</p> <p>Note: Notwithstanding the values of the above mentioned parameters, the design wind pressure so computed at any point shall not be taken less than 1500 N/Sq. metre for all classes of structures, i.e. A, B & C, as defined in IS: 875 (Part-3).</p>			
DARLIPALI SUPER THERMAL POWER PROJECT STAGE-I (2X800 MW) STEAM GENERATOR PACKAGE	TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO. : CS-9549-102-2	PART-A SUB SECTION-II APPENDIX-I TO ANNEXURE-VI	PAGE 17 OF 17	



TITLE :
TECHNICAL SPECIFICATION FOR
PLATE HEAT EXCHANGERS

SPECIFICATION NO. PE-TS-403-179-N001

VOLUME II B

SECTION C

REV. NO. 0

DATE 09.10.2014

SECTION C
SPECIFIC TECHNICAL REQUIREMENTS



TITLE :
**TECHNICAL SPECIFICATION FOR
PLATE HEAT EXCHANGERS**

SPECIFICATION NO. PE-TS-403-179-N001

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SHEET 1 OF 1

1.0 GENERAL :

The Plate heat Exchangers complete with all accessories including special tools and tackles (if any) shall conform to the standard technical specifications and Data Sheet-A of Section-D. In addition, the requirements of this Section C shall also be complied with. However, wherever the details given in Section-D and Data Sheet-A are different, the requirements of Data Sheet - A shall prevail. Similarly in the event of contradictions between Section - C & Section - D/ Data Sheet-A, Section-C shall prevail.

Number of Plate Heat Exchangers to be supplied for 2x800 MW NTPC DARLIPALI STPP-SG shall be as under:

Total Four (4) nos. PHE for SG Aux's

2.0 SYSTEM DESCRIPTION :

- 2.1 The Plate Heat Exchanger are intended to be used in closed circuit DM cooling water circuit for Cooling Hot passivated DM Water by Auxiliary Cooling Water (Clarified Water).
- 2.2 Passivated DM Water is circulated through various auxiliary coolers of TG, in closed loop by means of pumps. This DM water picks up heat from different cooling equipment's. Heat from DM water is transferred to auxiliary cooling water (Secondary side) thru' the Plate Heat Exchangers covered under this specification.
- 2.3 The analysis of DM Water, Clarified Water (Auxiliary cooling water) to be handled by the Plate Heat Exchangers are given in Data Sheet-A.
- 2.4 A strainer of 2 mm size at ACW inlet lines of PHE is provided and backwashing of PHE's is not envisaged.

3.0 SCOPE OF SUPPLY :

- 3.1 Number of Plate Heat Exchangers to be supplied shall be as under. For design parameters etc. refer Data Sheet-A enclosed herewith.

Total Four (4) nos. PHE for SG Aux's

- 3.2 Each Plate Heat Exchanger (quantity and other details specified in Data Sheet-A) shall be complete with the following accessories and auxiliaries.

- (i) Suitable drain and vent connections for both primary (DMCW) and Secondary Water (Clarified Water) streams complete with isolation valves.
- (ii) Supporting arrangement complete with foundation plate channels, anchor bolts, nuts, sleeves, inserts etc.
- (iii) Lifting arrangement i.e., lifting lugs, eye bolts etc.
- (iv) Matching counter flanges with necessary bolts, nuts, and gaskets for all flanged terminal points, including for DMCW and ACW inlet/outlet nozzles.
- (v) Inspection ports at the End plates of the PHE.
- (vi) Other accessories as required to make PHE's complete in all respects.
- (vii) Commissioning spares, if any.
- (viii) One Ratchet spanner per PHE is included in bidder's scope of supply.



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- (ix) Matching piece (Reducer/Expander), with coatings (as required), to match the PHE nozzle connection with connecting pipe size as indicated in Data Sheet.
- (x) Mandatory spares as applicable as per data sheet A.

3.3 Finish paints for touch-up painting of equipment after erection at site in sealed containers.

3.4 Various drawings, datasheets, test reports/ certificates, instruction manuals for erection, operation and maintenance etc., as specified in Data Sheet-C.

3.5 Based on the layout requirement, the nozzle orientation shall be for parallel flow viz. The inlet and outlet of DMCW flow shall be on the same side (vertically). And also the inlet and outlet of ACW flow shall be on same side (vertically).

4.0 INSPECTION REQUIREMENTS

4.1 Inspection for "Single pressing of plates to form whole corrugation of the heat transfer plate" shall be from third party like TUV/Lloyd and certificate shall be submitted for review of BHEL.

- The Pressing of HT plates shall be carried out in one operation.

4.2 DP Test shall be conducted for 10% of HT plates.
BHEL envisage witness of D.P. Test as follows:

- a. 1% witness by Customer.
- b. 2% witness by BHEL.

However during Contract Stage above percentage may vary from 1% to 10% for Customer & from 2% to 10% for BHEL without any commercial implication. However, in case of defect, entire lot shall be tested & only defect free plates shall be accepted.

4.3 10% of Light Box test or equivalent test (Vacuum test / Air Chamber test) shall be witnessed by BHEL/Customer/Third party (TUV/Lloyd or equivalent). However during Contract stage above percentage may vary from 10 to 100 % for BHEL/Customer without any cost implication to BHEL.

4.4 Minimum requirement for quality Plan shall be as per quality plan attached in the Section D of the Vol. IIB. Manufacturing Quality Plan for PHE shall be subject to approval during detail engineering. No price implication shall be admissible to QP approval by BHEL/Customer.

4.5 Hydraulic test for PHE's shall be performed at 1.5 times the design pressure with 30 minutes holding time for each side as per quality plan attached in the Section D of the Vol. IIB.

4.6 100% PMI Inspection for material grade of PHE Heat Transfer plates shall be from third party like TUV/Lloyd & certificate shall be submitted for review of BHEL.

4.7 BHEL reserves the right to conduct random & independent PMI inspection on PHE's Heat Transfer plates to ascertain the plate material.



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- 4.8 Heat transfer area for the PHE as offered by bidder with technical offer shall be measured by White light scanning method during contract stage to ascertain the correctness of heat transfer area as offered by bidder.

Inspection of plate area measurement for one heat transfer plate per PHE by White Light Scanning shall be from third party like TUV/Lloyd, same shall also be witnessed by BHEL. No type test certificates are acceptable to BHEL for same.

Bidder shall furnish the procedure for White Light Scanning method during detailed engineering viz. after award of contract which shall be subjected to BHEL/Customer approval. The Minimum requirement for White Light Scanning procedure is as per the Annexure-A of the quality plan attached in the Section D of the Vol. IIB.

Bidder to note that Heat Transfer Area measured by White Light Scanning during contract stage should not have negative tolerance more than 3% w.r.t to the heat transfer area indicated by bidder against the offered model of PHE. However in the case of negative tolerance (limited to maximum 3 percent) , bidder has to provide additional plates proportionately, as free issue, assembled into all the applicable PHE's before the Final inspection and "As built Certificate" shall be issued by the bidder accordingly. Bidder to note that negative tolerance beyond three percent shall not be accepted, however no credit shall be given to the bidder for positive tolerance of the plate area measurement.

5.0 PERFORMANCE GUARANTEE AND TESTING:

- 5.1 The PHE shall be guaranteed to meet the performance requirements specified in Section-D and also for trouble free operation after commissioning. Schedule of performance guarantees (enclosed in Volume-III) duly filled and signed shall be furnished with the bid.
- 5.2 PG test After commissioning of PHE's at site, performance test of all PHE's for each unit individually will be conducted by bidder at project site to ensure that the PHE's meet the specified requirements. In case of any deficiency, the vendor shall rectify the same at site with no additional cost to BHEL. All duly calibrated instruments required for PG testing including for flow measurements shall be arranged by the bidder and taken back after the Test. The computation of flow by characteristics curve of Pumps for PG Testing of PHE's shall not be permitted.
- 5.3 It is clarified that pressure gauges and temperature gauges are provided at each PHE inlet / outlet on both primary / secondary sides and bidder can install their calibrated instruments on these locations. It is further clarified that due to layout constraints flow measuring instruments installation on pipe is not feasible. Bidder shall arrange the Ultra-sonic flow meter / similar type of instrument for PG testing.
- 5.4 At the time of performance testing, cleaning of the plates (if required) and instruments like pressure gauges, temp. Gauges, flow measuring instruments etc. shall be arranged by the bidder and no instruments shall be provided by BHEL for performance testing.



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SHEET 1 OF 1

6.0 SPARES :

6.1 **Mandatory Spares:** Shall be as per data sheet A.

7.0 DOCUMENTS TO BE SUBMITTED ALONG WITH OFFER:

No document other than the following is required to be submitted by bidder with the offer unless bidder considers it absolutely necessary.


- a) Compliance certificate as enclosed in Volume III
- b) Schedule of Deviations if any.
- c) Guarantee Schedule.
- d) Thermal sizing calculations.
- e) Schedules of Price & Unit Price as per NIT format.
- f) GA Drg. of PHE indicating all-important details for Layout purpose, withdrawal space required for plates, weight of assembly, nozzle & matching piece details etc.
- g) Confirmation of plate area of the offered model, duly endorsed from the Head of Engg./R&D of Principal supplier of the plate.
- h) Schedule of declaration.

7.1 Other Drawings/ documents etc. shall be submitted by successful bidder after the award of contract as per NIT.

8.0 EXCLUSIONS :


The following are excluded from the bidder's scope:

- 8.1 Civil foundation works required for installation of the heat exchangers.
- 8.2 Piping, valves etc., on the external circuit of both primary and secondary water streams.
- 8.3 Erection & Commissioning of equipment at site.

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SECTION - D
PLATE HEAT EXCHANGER
STANDARD TECHNICAL SPECIFICATION
DATA SHEET C
STANDARD QUALITY PLAN

DMS (BHEL-PEM)
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1.00.01 GENERAL

This specification covers the Design, Performance requirements, Constructional Features, Materials requirements, manufacture, assembly, Inspection and Testing at Manufacturer's and/ or his subcontractor's works and Painting requirements for delivery of Plate Heat Exchanger complete with all accessories as specified herein-after.

2.00.00 CODES AND STANDARDS:

2.01.00 The design, manufacture and testing of the plate heat exchanger complete with all accessories, shall generally conform to the latest editions of the following appropriate standards.

2.01.01 IS/BS/DIN/US Standards regarding pressure vessels, pressure piping, pipes, valves, flanges and other as necessary.

2.01.02 IS/ BS/ DIN/ ASTM for material specification and testing procedures.


2.02.00 In case of any conflict between the above codes/ standards and this specification, the latter shall prevail and in case of any further conflict in the matter, the interpretation of the specification by the Engineer shall be final and binding

3.00.00 DESIGN AND CONSTRUCTION:

3.01.00 General Requirements:

3.01.01 Unless otherwise necessary, manufacture's standard and proven models of the plate heat exchanger shall be supplied.

3.01.02 The equipment shall be capable of safe, proper and continuous operation at all heat loads and water from up to those corresponding to the operating conditions mentioned in Data Sheet – A furnished a/w project enquiry. Vibration, noise, mechanical and thermal stresses shall be kept

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within allowable units specified by relevant codes/ standards in design. Due attention shall be given to *case of maintenance, repair and cleaning.*

3.01.03 Suitable corrosion allowance shall be provided wherever necessary. The corrosion allowance for the heat exchanger parts such as pressure plates (support plates), nozzles, sliding channels and frame shall be 1.6 mm (minimum).

3.01.04 Each heat exchanger shall be capable of passing a flow of at least 1.1 times the design flow rate on both primary and secondary water sides. Bidder shall indicate maximum pressure drop through the heat exchanger under this condition.

3.01.05 For the purpose of calculating dirty overall heat transfer coefficient, a total fouling factor as given in Data Sheet-A furnished a/w project enquiry shall be assumed. It is expected that the cleaning frequency shall be once in a year with the above fouling factor.

3.01.06 No back wash for the heat exchangers is envisaged.

3.02.00 Performance Requirements:


3.02.01 The pressure drop across plate heat exchanger from inlet to outlet in fouled conditions for primary and secondary sides, shall not be more than those specified in Data Sheet-A furnished a/w project enquiry, for the specified flow rates.

3.02.02 For the specified flow rate and inlet temperature, the primary side (hot fluid) outlet temperature shall not be more than that specified in Data Sheet-A furnished a/w project enquiry.

3.02.03 In the event of failure to meet the above stipulated performance requirements, the equipment will be out rightly rejected.

3.03.00 Construction of Heat Exchanger:

3.03.01 Heat transfer plates shall be packed in a frame consisting of fixed frame plate and movable pressure plate and aligned at top and bottom of carrying bars. Design shall be such that cleaning is possible without dismantling the piping.

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3.03.02 Heat transfer plates shall be sealed at their outer edges and around the ports by gaskets in order to prevent leakage and inter-mixing of fluids.

Double sealing arrangement shall be provided at outer edge and around ports. The inter space between the seals shall be vented to atmosphere in order to avoid inter-mixing of liquids in case of gaskets failure.

The gasket arrangement shall be such that it receives continuous support to ensure a long gasket life. The gasket should be able to retain their properties and shape over a life period of 10 years.

3.03.03 Heat transfer plates shall be provided with sufficient thickness in order to impart sufficient rigidity to the plates particularly from handling considerations. Plates shall have contact points in order to provide inter-plate supports. The recesses on the plates are suitably strengthened by a reinforcement plate.


Plate thickness shall be adequate to withstand all operating conditions as specified in data sheet A furnished a/w project enquiry.. Flanges shall be as per ANSI 16.5 or equivalent. Thickness of pressure and frame plates shall be as per ASME Sect. VIII div.1.25% extra capacity for additional plates shall be provided in frame.

Each Plate shall be numbered in sequence. The number shall be marked by indelible ink on the plate to permit easy reassembly. The plates shall be pressed from one piece. They shall be pressed in single/ progressive manner.

The corrugation shall be smooth, uniform and identical for every plate. The PHE bottom frame plate and support should have fixing lugs and cleats to keep provision for enabling to fit trough with outlet nozzle fitted underneath to collect and drain out water in the event of leakages.

3.03.04 Frame for each heat exchanger shall have extra capacity to accommodate the additional plates, if required in future because of any reason whatsoever. The extra capacity to be provided is indicated in Data Sheet-A furnished a/w project enquiry.

The upper carrying bar and lower guide bar shall be rigid in construction

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without any risk of sagging or buckling, and shall facilitate easy guiding of the plates.

3.03.05 All inlet, outlet and other nozzles shall be flanged type and shall be as specified in Data Sheet-A. Counter flanges complete with gaskets, bolts, nuts and coatings (wherever necessary) shall be supplied for the nozzle connections. The nozzle sizes of primary/ secondary streams of PHE's shall be of adequate size within acceptable range of velocity. The size selection shall be subject to approval in the event of order.

3.03.06 If necessary, relief valves shall be provided on both the streams.

3.04.00 **Materials of construction:**

Material of the heat transfer plates and gaskets shall be consistent with the fluid handled. However, material specification for various parts shall be equal or superior to those specified in Data Sheet - A furnished a/w project enquiry.

4.00.00 **FOUNDATION AND LIFTING ARRANGEMENTS:**

4.01.00 Plate heat exchanger shall be supplied with necessary foundation plates, anchor bolts, sleeves, nuts, inserts etc.


4.02.00 Plate heat exchanger shall be equipped with suitable lifting lugs/ eyebolts to facilitate handling during erection and maintenance.

5.00.00 **PAINTING:**

5.01.00 The surface preparation of all exterior and interior surfaces of plate heat exchanger shall include the following:

- a) Removal of oil, grease, dirt and swarf etc
- b) Removal of rust and scale etc.,
- c) Sand blasting/ shot blasting.

5.02.00 All exterior surfaces of PHE's shall be sand/ shot blasted, painted with

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primer and finish coated with coal tar based epoxy coating of min. 250 microns thickness. Color shade etc. shall be subject to BHEL/ Customer approval.

6.00.00 **SHOP INSPECTION AND TESTS:**

6.01.00 **General:**

6.01.01 Manufacturer shall conduct all tests and stage inspections as per the approved quality plan to ensure that the plate heat exchanger shall conform to the requirements of this specification and of the applicable codes/ standards.

6.01.02 All materials used for manufacture/ fabrication of the plate heat exchanger components shall be of tested quality. Relevant test certificates for chemical analysis, mechanical tests and heat treatment shall be made available before the final shop inspection. In case the relevant test certificates are not available, the manufacturer shall arrange to carry out the necessary tests required as per approved quality plan and applicable codes at his cost, for which samples shall be identified by BHEL's representative.


6.01.03 All shop tests shall be conducted in the presence of BHEL's representative and test certificates for the same shall be furnished to BHEL for approval.

6.01.04 Qualification of welding procedures and welders shall be as per ASME B&PV Code, Section-IX/applicable code.


6.02.00 **Heat Transfer Plates:**

6.02.01 Plate material used for pressing shall be furnished with mill test report showing chemical and physical properties and heat treatment records. Suitable correlating mark shall be available, so that BHEL's inspector can identify the material with test certificates before pressing the plates.

6.02.02 After pressing visual and dimensional checks on the plates shall be made in the presence of BHEL's inspector, on sampling basis.

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- 6.02.03 The heat transfer plates from each lot of the plates shall be tested by liquid/ dye penetrant test in order to check for cracks and other surface defects in presence of BHEL/customer's representative/Third party (Llyods, TUV or equivalent). If any defect is detected in any of these plates, the whole lot shall be tested and plates without defects only shall be accepted. Plate cleaning agent, liquid penetrant and developer shall not contain any halogen .Procedure for light box test and DP test shall be submitted to purchaser's approval. For Quantum of check , Refer Section C.
- 6.02.04 The heat transfer plates shall be tested by light box test in order to check for cracks and other surface defects in presence of BHEL/customer's representative/Third party (Lloyds', TUV or equivalent). The plates without defects only shall be accepted. For Quantum of check , Refer Section C.
- 6.03.00 **Gaskets:**
- 6.03.01 Certificate on Chemical composition of the gasket material shall be furnished to prove the quality. Sample testing in presence of BHEL's inspector shall also be conducted, if desired.
- 6.03.02 Shore hardness test shall be conducted on the gasket and certificate shall be furnished. Sample tests shall also be done in presence of BHEL's inspector.
- 6.03.03 Visual and dimensional check on a sampling basis shall be done. Plates and gaskets assembled together will be inspected for proper assembly.
- 6.04.00 **Frame Assembly:**
- 6.04.01 All materials for various components of frame assembly viz. frame plate, pressure plate, carrying bar, guide bar, tightening/ clamping bolts and nuts etc., shall be of tested quality and test certificates for chemical composition and physical properties shall be furnished.
- 6.04.02 If the thickness of the plates used for frame and pressure plates is 40 mm or more the same shall be checked ultrasonically to demonstrate the absence of lamination and lack of fusion etc.
- 6.05.00 All weld joints used for Fabrication of Heat exchangers shall be subjected to suitable non destructive examination. This shall include 100 % magnetic particle examination or other suitable NDT of all welds.

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7.00.00 **Document submission:**

7.01.00 The tenderer shall submit during contract stage a curve showing expected DM Water (Primary side) temperature at heat exchanger outlet for each one degree centigrade variation in ACW (Secondary side) temperature, all other parameters remaining unchanged. Similar curve for expected DM Water outlet temperature for variation of ACW flow rate with ACW inlet temperature remaining unaltered shall also be furnished. The bidder shall also furnish various curves to enable, apply corrections during site PG testing in the event of any data variation from the stipulated design parameters.

7.02.00 Bidder shall also furnish thermal design calculations at contract stage to justify the no. of plates offered.

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TECHNICAL SPECIFICATION FOR

Technical specification No.

PE-TS-403-179-N001

PLATE HEAT EXCHANGER

Vol/Section

IIB/D

DATASHEET - A

Rev

0

date

09.10.14

SL. NO.	DESCRIPTION		UNIT	
	PROJECT			2 X 800 MW NTPC DARLIPALI STPP -SG PKG
1.0	General			
1.1	Number of Plate Heat Exchanger		Nos	Total Six (4) nos [1W+1S Per Unit]
1.2	Arrangement			2X100% per unit
1.3	Location			Outdoor
1.4	Primary side (Hot) Fluid			Passivated DM water (Ref enclosed water analysis)
1.5	Secondary side (Cold) fluid			Cooling Water (Ref enclosed water analysis)
1.6	Connecting Pipe size	(Primary Side)	NB	300
		(Secondary Side)	NB	400
2.0	Design			
2.1	Design Pressure		Kg/cm ² (g)	12
2.2	Operating Pressure	(Primary Side)	Kg/cm ² (g)	About 8.8 Kg/sq. cm
		(Secondary Side)	Kg/cm ² (g)	About 3.2 Kg/sq cm
2.3	Mechanical Design Temp.		°C	60
2.3	Heat Transfer per Sq.Mtr. Of Heat Transfer Plate		Kcal/Hr./m ²	6500 (Max.)
2.4	Minimum Heat Transfer Area		Sq. M.	-
2.5	Specific Heat of Fluid	(Primary Side)	Cal/gmDeg.C	1.0
		(Secondary Side)	Cal/gmDeg.C	1.0
2.6	Density of Fluid	(Primary Side)	gm/cc	1.0
		(Secondary Side)	gm/cc	1.0
3.0	Guaranteed Performance Requirements for each Heat Exchangers in fouled condition:			
3.1	Flow rate	(DMCW Side)	M ³ /hr	500
		(ACW Side)	M ³ /hr	900
3.2	Inlet temperature	(DMCW Side)	°C	44.6
		(ACW Side)	°C	36
3.3	Outlet temp	(DMCW Side)	°C	38
		(ACW Side)	°C	39.7
	* Allowable pressure drop across heat	(DMCW Side)	MWC	7



TECHNICAL SPECIFICATION FOR PLATE HEAT EXCHANGER DATASHEET - A		Technical specification No.	PE-TS-403-179-N001
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SL. NO.	DESCRIPTION	UNIT	
PROJECT		2 X 800 MW NTPC DARLIPALI STPP -SG PKG	
3.4	exchanger from inlet to outlet in fouled conditions at design flow (ACW Side)	MWC	7
* High pressure drop than the specified figure will not be accepted, no credit shall be, however, given for lower pressure drop in bid evaluation. Pressure drop mentioned shall be calculated against flow mentioned at S. No 3.1			
4.0	Additional HT plates on Design Plates	%	NIL
5.0	Heat Transfer Coefficient/Margin		
5.1	Overall fouling resistance	Hr m ² deg C/Kcal	0.00008
5.2	Minimum corrosion allowance (refer note 1)	mm	1.6
6.0	Material of Construction :		
6.1	Heat Transfer Plates (Minimum acceptable plate thickness 0.6 mm). Refer Note no. 3		SS-AISI-316
6.2	Plate Gasket		Nitrile Rubber
6.3	Compression/ Pressure plates		Carbon steel to IS-2062 Gr. B, Epoxy painted
6.4	Guide Rails/ bar		Carbon steel to IS-2062 Gr. B, Epoxy painted with stainless steel cladding
6.5	Support Beam/ column		Carbon steel to IS-2062 Gr. B, Epoxy painted
6.6	Nozzle		Carbon steel to IS-2062 Gr. B, Epoxy Painted
6.7	Nozzle flanges		Carbon steel to IS-2062 Gr. B, Epoxy Painted
6.8	Flange/ Counter flanges		Carbon Steel as per IS 2062 Gr. B (Confirming to ANSI B 16.5 class, Min.-150 lb)
6.9	Tie Bolts & Nuts		IS-1367 Gr 8.8 or equivalent
6.10	Nozzle flange bolt and nut		SA 193 B7/ SA 194 2H
6.11	Nozzle flange gasket		3mm wire inserted Red Rubber
6.12	Name Plate		SS- AISI-316
6.13	Painting		
	External Surface		



TECHNICAL SPECIFICATION FOR PLATE HEAT EXCHANGER DATASHEET - A		Technical specification No.	PE-TS-403-179-N001
		Vol/Section	IIB/D
		Rev	0
		date	09.10.14
SL. NO.	DESCRIPTION	UNIT	
	PROJECT		2 X 800 MW NTPC DARLIPALI STPP -SG PKG
	a.) Surface Preparation		All surface other than stainless steels shall be painted. The steel surface to be applied with painting shall be thoroughly cleaned before applying painting by shotblasting etc shall be subjected to BHEL/NTPC approval.
	b.) Primer		For all the steel surfaces inside the (indoor installation) building, a coat of red oxide primer of minimum thickness of 50 microns followed up with undercoat of synthetic enamel paint of minimum thickness of 50 microns shall be applied. The top coat shall consist of two coats each: of minimum thickness of 50 microns of synthetic enamel paint and thus total thickness shall be minimum 200 microns.
	c.) Final Paint		
7.0	Extra Carrying capacity to be provided on frame assembly.	%	25
8.0	Mandatory Spares		
8.1	Plates		2 % of each type
8.2	Gaskets		30% of total requirement
8.3	Fasteners		NIL
8.4	Valve		NIL
8.5	Definitions Regarding %	-	Quantity shall be calculated for % of total population of item in the project (if in fraction, round-off to next higher whole no.)
9.0	Available space (L x W x H)	mm	----- Bidder to indicate -----
10.0	Weight of Assembly	Kg	----- Bidder to indicate -----
11.0	Performance Testing		All supplied PHE to be tested by vendor at site to demonstrate guaranteed performance.
12.0	Performance curves and figures to be furnished during contact stage		
12.1	Primary side water outlet temperature vs. Secondary side water inlet temperature.		
12.2	Primary side water flow (80% to 115%) vs. Pressure drop and outlet temperature (Secondary side flow – 100%)		
12.3	Secondary side water flow (80% to 115%) vs. Secondary side pressure drop and primary side outlet temp (Primary side flow – 100%)		
12.4	Primary side water outlet temperature vs. Primary side inlet temp.		
12.5	Film heat transfer coefficient curve		
12.6	Correction Curves.		
Note: 1	Minimum Corrosion allowance on thickness (as per ASME Sec. VIII Div. I)		
2	Metallurgy shall be suitable for type of water handled for various plates.		
3	Minimum plate thickness of 0.6 mm is without any negative tolerance.		

DM Water analysis:

• Conductivity	Less than 0.1 microS/cm
• Total silica	Less than 0.02 ppm
• pH	pH 8.5 to 9.5

CLAUSE NO.

PROJECT INFORMATION



Annexure – III

DESIGN CLARIFIED WATER ANALYSIS

S.No	Constituent	As	mg/l
1	Calcium	CaCO ₃	135
2	Magnesium	CaCO ₃	88
3	Sodium	CaCO ₃	40
4	Potassium	CaCO ₃	9
	Total cations	CaCO ₃	272
4	HCO ₃	CaCO ₃	173
5	P-alkalinity	CaCO ₃	0
6	Chloride	CaCO ₃	36
7	Sulphate	CaCO ₃	63
	Total Anions	CaCO ₃	272
8	Silica, Reactive	Si	8
9	Iron (Total)	Fe	0.5
10	pH		7.0- 7.8
11	Turbidity	NTU	10
12	Total Dissolved Solids		210-270
13	Temperature	⁰ C	20 - 35

Note : The C.W system is expected to operate at about 3 Cycles of Concentration. As CW blow down water (Service Water) is tapped from discharge of CW pumps, the water quality of CW Blow down water shall be same as that above.

STANDARD QUALITY PLAN		CUSTOMER:		PROJECT TITLE:			SPECIFICATION NO. :							
SHEET OF		BIDDER/VENDOR:		QUALITY PLAN NO.:			SPECIFICATION TITLE :							
		SYSTEM:		ITEM: PHE			SECTION :							
SL. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CAT	TYPE/METHOD OF CHECK	EXTENT OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS	
					2/3	1				P	W	V		
1.	2.	3.	4.	5.	6.		7.	8.	9.	D*	**	10.	11.	
1.0 RAW MATERIAL INSPECTION														
1.1	Frame Plates & Pressure Plates, Counter Flanges, Connection Lining Material.Top And Bottom Carrying Bar.	Physical Properties	MA	Physical Test	1/ Heat/He -at Batch	1/ Heat/He -at Batch	App. Drg / Data Sheet	Relevant material spec.	Mill TC Or Lab Test Report	√	2,3	-	1	If co-related mill TCS are not available then check testing carried out by reputed lab
		Chemical Properties	MA	Chemical Analysis	1/ Heat/He -at Batch	1/ Heat/He -at Batch	-do-	-do-	-do-	√	2,3	-	1	-do-
		Dimensions	MA	Measurement	100%	100%	Approved Drawings		Inspection Reports	√	2,3	-	1	
		Workmanship And Finish	MA	Visual	100%	100%	-do-	-do-	-do-		2,3	-	1	
		Lamination (Applicable For Frame And Pressure Plate Only)	CR	Ultrasonic Test	100%	100%	SA 435	SA 435	-do-	√	2,3	-	1	Applicable for plate thickness more than 25 mm only
1.2	Heat Transfer Plates	Physical Properties	MA	Physical Test	1/ Heat	1/ Heat	App. Drg. / Data Sheet	App. Drg. / Data Sheet	Mill TC Or Lab Test Report	√	2,3	-	1	Co-related mill TCS to be provided See Remark 1
		Chemical Properties	MA	Chemical Analysis	1/ Heat	1/ Heat	-do-	-do-	-do-	√	2,3	-	1	-do-
		Dimensions	MA	Measurement	100%	Sample	Approved Drawings		Inspection Reports	√	2,3	-	1	
1.3	Gaskets	Dimensions	MA	Measurement	100%	Sample	Approved Drawings		Inspection Reports		2,3	-	1	Co-related mill TCS to be provided See Remark 1
		Workmanship And Finish	MA	Visual	-do-	-do-	No damage, No Surface defects.		-do-		2,3	-	1	
		Contour	MA	Visual	-do-	-do-	Mfg. Drgs / specification		-do-		2,3	-	1	

MANUFACTURER/ SUB-SUPPLIER		MAIN-SUPPLIER	LEGEND: * RECORDS, IDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. ** 1: BHEL 1* SHALL BE CLEARED BY BHEL 2: VENDOR, 3: SUB VENDOR P: PERFORM W: WITNESS AND V: VERIFICATION. AS APPROPRIATE CHP: CUSTOMER SHALL IDENTIFY IN COLUM "N" AS ' W'	Cust. Logo	DOC. NO.:		REV.	CAT.-
SIGNATURE					FOR CUST. USE	REVIEWED BY	APPROVED BY	APPROVAL SEAL

STANDARD QUALITY PLAN		CUSTOMER:		PROJECT TITLE:			SPECIFICATION NO. :							
SHEET OF		BIDDER/VENDOR:		QUALITY PLAN NO.:			SPECIFICATION TITLE :							
		SYSTEM:		ITEM: PHE			SECTION :							
SL. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CAT	TYPE/ METHOD OF CHECK	EXTENT OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS	
					2/3	1				P	W	V		
1.	2.	3.	4.	5.	6.		7.	8.	9.	D*	**	10.	11.	
		Hardness	CR	Measurement	-do-	-do-	Approved Drawings		-do-	√	2,3	-	1	
1.4	Tightening Bolts & Nuts. (Tie Rod)	Physical Properties	MA	Physical Test	1/ Heat	1/ Heat	App. Drg / data sheet	Relevant Material Spec.	Mill Tc Or Lab Test Report	√	2,3	-	1	Manufacturer test certificate will be submitted for review.
		Chemical Properties	MA	Chemical Analysis	1/ Heat	1/ Heat	-do-	-do-	-do-	√	2,3	-	1	-do-
		Dimensions	MA	Measurement	100%	100%	Approved Drawings		IR	√	2,3	-	1	
		Workmanship and Finish	MA	Visual	100%	100%	-do-	-do-	-do-		2,3	-	1	
		Internal Soundness (For diameter >= 40 mm)	CR	UT	100%	100%	ASTM A 388	See Remark - 3	-do-	√	2,3	-	1	UT will be carried on raw material stage.
2.0	IN PROCESS INSPECTION													
		Area Measurement	NA	White Light Scanning	1 per Type	1 per Type	Approved drawing/ data sheet	Approved drawing/ data sheet	IR	√	2,3	-	1	Refer Point No. 3 of remarks
	HT PLATES	Physical Properties	MA	Physical Test	1 Sample per Heat	1 Sample per Heat	Approved drawing/ data sheet	Relevant Material Spec.	Mill TC or Lab Test Report	√	2,3	-	1	Manufacturing test certificates will be submitted for review.
		Chemical Properties	MA	Chemical Analysis	1 Sample per Heat	1 Sample per Heat	Approved/ drawing/ data sheet	Relevant Material Spec.	Mill TC or Lab Test Report	√	2,3	-	1	Manufacturing test certificates will be submitted for review.
		Dimension	MA	Measurement	1 Sample per Heat	1 Sample per Heat	Approved drawing/ data sheet	Approved drawing/ data sheet	Inspection Report	√	2,3	-	1	

MANUFACTURER/ SUB-SUPPLIER	MAIN-SUPPLIER	SIGNATURE	LEGEND: * RECORDS, IDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. ** 1: BHEL 1* SHALL BE CLEARED BY BHEL 2: VENDOR, 3: SUB VENDOR P: PERFORM W: WITNESS AND V: VERIFICATION. AS APPROPRIATE CHP: CUSTOMER SHALL IDENTIFY IN COLUM "N" AS ' W"	Cust. Logo	DOC. NO.:			REV.	CAT-
					FOR CUST. USE	REVIEWED BY	APPROVED BY	APPROVAL SEAL	

SL. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CAT	TYPE/ METHOD OF CHECK	EXTENT OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS		
					2/3	1				P	W	V			
1.	2.	3.	4.	5.	6.		7.	8.	9.	D*	**	10.	11.		
		Workmanship And Finish	MA	Visual	100%	100%	Approved drawing/ data sheet	No scratches, cracks etc.	-do-		2,3	-	1		
		Surface Defects And Cracks	CR	DP test	Refer Sect. C , Clause No. 4.2	Refer Sect. C , Clause No. 4.2	Manufacturer's DP test procedure (to be reviewed and approved by BHEL/Customer during contract stage)		DPT Report	√	2,3	1	-	See Remark 1	
				Light Box Test/ Vacuum chamber test	100%	10%	Manufacturer's Light Box/Vacuum test procedure (to be reviewed and approved by BHEL/Customer during contract stage)		Vacuum Test Report	√	2,3	1	-	See Remark 1	
2.1	Welding Procedures Specification (WPS)	Correctness	MA	Verification	100%	100%	ASME SEC-IX.	ASME SEC-IX.	QW 482 ASME SEC-IX	√	2,3	-	1	Customer /BHEL/ TPI (NPCIL, EIL, LLYODS & BVIS) approved WPS shall be used for welding	
2.2	Procedure Qualification Records (PQR)	Suitability	MA	Visual & Mechanical Test	100%	100%	-do-	-do-	QW 483 ASME SEC-IX.	√	2,3	-	1		
2.3	Welders Performance Qualification	Welder's Performance Soundness Of Welds	MA	Visual / RT & Mechanical	100%	100%	-do-	-do-	QW 484 ASME SEC-IX	√	2,3	-	1	Only customer / BHEL/ TPI (NPCIL, EIL, LLYODS & BVIS) approved welder shall be engaged for welding.	
2.4	Weld joint of expander/reducer.	Welding Of Outer Flange To Reducer/Expander	MA	Visual	100%	100%	Approved Drawings		Inspection Report	√	2,3	-	1		
				DPT	100%	100%	Manufacturer's DP test procedure (to be reviewed and approved by BHEL/Customer during contract stage)		DPT Report	√	2,3	1	-		
MANUFACTURER/ SUB-SUPPLIER		MAIN-SUPPLIER		LEGEND: * RECORDS, IDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. ** 1: BHEL 1* SHALL BE CLEARED BY BHEL 2: VENDOR, 3: SUB VENDOR P: PERFORM W: WITNESS AND V: VERIFICATION. AS APPROPRIATE CHP: CUSTOMER SHALL IDENTIFY IN COLUM "N" AS ' W"				Cust. Logo		DOC. NO.:		REV.		CAT-	
SIGNATURE								FOR CUST. USE		REVIEWED BY		APPROVED BY		APPROVAL SEAL	

FORMAT NO.: QS-01-QAI-P-09/F1-R1

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ENGG. DIV./QA&I

SL. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CAT	TYPE/ METHOD OF CHECK	EXTENT OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS	
					2/3	1				P	W	V		
1.	2.	3.	4.	5.	6.		7.	8.	9.	D*	**	10.	11.	
2.5	PHE Structure	Workmanship and finish	MA	Measurement & Visual	100%	100%	Approved Drawings		Inspection Report	√	-	2	1	
2.6	Plate Gaskets	Presence Of Gasket	MA	Visual	100%	100%	Mfg. Spec.	Mfg. Spec.	-do-	√	2	1	-	
2.7	Plate arrangement to flow diagram	Correctness	CR	Visual as per flow diagram	100%	100%	Approved Drawing		Inspection Report		2	-	1	
2.8	Assembly of tightening bolts and nuts	Squeezing of threads on T/B	MA	Visual	100%	100%	Approved Drawing / Data sheet		-do-		2	-	1	
2.9	Plate Pack	Length	MA	Dimension Measurement	100%	100%	Approved Drawing		-do-		2	-	1	
3.0	FINAL INSPECTION													
3.1	Complete Assembly	a. Conformance to GA drg.	MA	-do-	100%	100%	-do-	-do-	-do-		2	1	-	CHP
		B. Dimensions, No. of Heat Transfer Plates, Workmanship & finish	MA	-do-	100%	100%	-do-	-do-	-do-	√	2	1	-	CHP
3.2	Unbalanced hydrostatic pressure (Primary Side)	Leakage / strength of structure	MA	Hyd. Test	100%	100%	Manufacturer's Hydro test procedure (to be reviewed and approved by BHEL/Customer during contract stage)		Hydro Test Report	√	2	1	-	CHP.
3.3	Unbalanced hydrostatic pressure (Secondary Side)	Leakage / strength of structure	MA	Hyd. Test	100%	100%	-do-		-do-	√	2	1	-	CHP.

		LEGEND: * RECORDS, IDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. ** 1: BHEL 1* SHALL BE CLEARED BY BHEL 2: VENDOR, 3: SUB VENDOR P: PERFORM W: WITNESS AND V: VERIFICATION, AS APPROPRIATE CHP: CUSTOMER SHALL IDENTIFY IN COLUMN "N" AS ' W"	Cust. Logo	DOC. NO.:	REV.	CAT.-
MANUFACTURER/ SUB-SUPPLIER	MAIN-SUPPLIER					
SIGNATURE			FOR CUST. USE	REVIEWED BY	APPROVED BY	APPROVAL SEAL

FORMAT NO.: QS-01-QAI-P-09/F1-R1

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ENGG. DIV./QA&I

SL. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CAT	TYPE/ METHOD OF CHECK	EXTENT OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS	
					2/3	1				P	W	V		
1.	2.	3.	4.	5.	6.		7.	8.	9.	D*	**	10.	11.	
3.4	Completeness of all previous tests	Completeness	MA	Verification of reports	100%	100%	Tech. Specs / App. Drawings		Completion Certificate	√	2	-	1	
3.5	Painting and packing	Dry film thickness, shade, soundness & completeness	MA	Measurement & visual	100%	100%	Customer/BHEL Tech. Spec. / Approved Data sheets		-do-	√	2	-	1	Packing photograph shall be submitted by vendor along with TCs
REMARKS:-														
1	As per Sect. C , Clause No. 4.2, random witness by BHEL/ NTPC at Bidder's works, in case any defect is found in any of selected % of plates, the whole lot shall be tested in presence of BHEL & Customer. H.T. Plates without defect only shall only be accepted.													
2	Ultrasonic test of tie rods shall be carried out using 10 mm / 20 mm size Normal Beam Probe of frequency 2 MHz. Using this probe the back wall echo in the sound area of bar shall be adjusted to 100% of full Screen Height (FSH). The whole bar shall be scanned under this sensitivity setting. In this sensitivity setting any defect echo indication having height greater than 20% of FSH is not acceptable.													
3.	Inspection of Heat Transfer Plate Area Measurement shall be by White Light Scanning Method from Third Party like TUV/ Lloyd and certificate shall be submitted for review of BHEL.													

		LEGEND: * RECORDS, IDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. ** 1: BHEL 1* SHALL BE CLEARED BY BHEL 2: VENDOR, 3: SUB VENDOR P: PERFORM W: WITNESS AND V: VERIFICATION. AS APPROPRIATE CHP: CUSTOMER SHALL IDENTIFY IN COLUM "N" AS ' W"	Cust. Logo	DOC. NO.:	REV.	CAT.-
MANUFACTURER/ SUB-SUPPLIER	MAIN-SUPPLIER		FOR CUST. USE			
SIGNATURE				REVIEWED BY	APPROVED BY	APPROVAL SEAL

FORMAT NO.: QS-01-QAI-P-09/F1-R1

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**PROCEDURE FOR MEASUREMENT OF HEAT TRANSFER SURFACE AREA OF THE
PHE PLATES**

Definition of Heat transfer area:

The Heat transfer area of the PHE plate is the area of the plate participating in the heat transfer process viz. the wetted surface area inside the gasketed groove of the plate as the Annexure 1.

Steps to Measure the Area:

- 1) The surface area of the plate shall be cleaned thoroughly.
- 2) Apply the developer (as used in Dye Penetrant test) over the entire surface of the plate.
- 3) Fix the reference stickers at several appropriate locations on the plate.
- 4) White light (CFL) is projected on the plate.
- 5) The entire surface area including all the geometrical features of the plate (corrugations) is captured by the 3D camera.
- 6) The 3D image of the plate is then converted into CAD format.
- 7) The surface area can be measured from the 3D- CAD drawing.

ANNEXURE -1

Heat transfer area to be measured – Shown in Hatched portion below

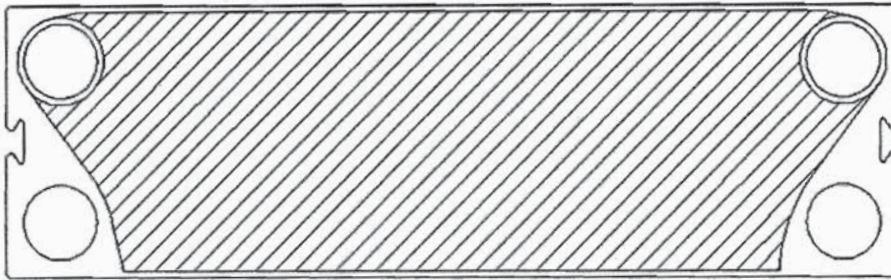


Fig. 1: Wetted Surface Area for Parallel Connection

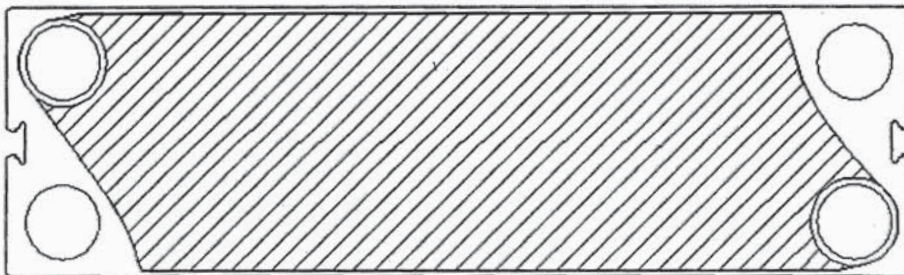


Fig. 2: Wetted Surface Area for Diagonal Connection