

**NTPC, 2X195 MW MUZAFFARPUR TPP**

**VOLUME –IIB**

**TECHNICAL SPECIFICATION  
FOR  
PLATE HEAT EXCHANGERS**

**Specification No. : PE-TS-358-179-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-358-179-N001

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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 equipments 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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**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), 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 following project.

NTPC, 2X195 MW MUZAFFARPUR TPP

**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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**SECTION B**  
**PROJECT INFORMATION**



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**SECTION B-1**

**NTPC, 2X195 MW MUZAFFARPUR TPP**

CLAUSE NO.	PROJECT SYNOPSIS	एनटीपीसी NTPC
	PROJECT SYNOPSIS	
1.00.00	<p><b>BACKGROUND</b></p> <p>A Memorandum of Agreement (MOA) was signed among Govt. of Bihar, Bihar State Electricity Board (BSEB) and NTPC Limited on 26.12.2005 with an intent to promote a joint venture company namely Vaishali Power Generating Company (VPGCL) with the aim of taking over further reviving and operation of Muzaffarpur TPS (2x110 MW) and object of establishment, operation and maintenance of thermal power project having an equity participation of NTPC 51% and BSEB 49%. VPGCL has been incorporated with the Registrar of Companies, Delhi &amp; Haryana on 06.09.2006. Subsequently, the name of the company has been changed to Kanti Bijlee Utpadan Nigam Limited (KBUNL) on 10.04.08. Further, as per MOA JV Company has taken up expansion of Muzaffarpur TPS (MTPS) by implementing (2x195 MW) coal based thermal power project at Kanti in Muzaffarpur district of Bihar state for meeting the power demand of Bihar State and other willing customers after meeting the demand of Bihar State.</p>	
2.00.00	<p><b>LOCATION AND APPROACH</b></p> <p>The project is located at village Kanti in Muzaffarpur district of Bihar State having latitude and longitude of 26° 11' 40" N and 85° 18' 13" E respectively. The project is situated on Muzaffarpur-Motihari section of National Highway No. 28 at a distance of about 1.5 kms Kanti railway station on Samastipur-Motihari loop and about 13 kms from Muzaffarpur Railway Station of East-Central Railway. The nearest town Muzaffarpur is about 13 kms.</p> <p><b>Airport</b></p> <p>The nearest commercial airport is Patna at a distance of about 90 kms from the project site.</p> <p>The vicinity plan of the project site is placed at Annexure – 1</p>	
3.00.00	<p><b>LAND</b></p> <p>The project is planned to be accommodated within existing premises of MTPS. However, about 415 acres of land will be required for ash-pond and other corridors.</p> <p>Govt. of Bihar has been approached for in-principle clearance for availability of 415 acres of land vide letter dated 21.02.2008.</p>	
4.00.00	<p><b>WATER</b></p>	
4.01.00	<p><b>WATER SOURCE</b></p> <p>Raw water is proposed to be used for meeting the complete water requirement of the project. The source of raw water for the project is river Burhi Gandak which is at a distance of about 4 kms from the plant boundary.</p>	
MUZAFFARPUR THERMAL POWER PROJECT STAGE-II (2X195 MW) MAIN PLANT PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI PART-A BID DOCUMENT NO.: CS-0350-108-2
		CHAPTER-A0 PROJECT SYNOPSIS PAGE 1 OF 11



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**SECTION C**  
**SPECIFIC TECHNICAL REQUIREMENTS**





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**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 shall be as under:

- Total Four (4) nos.PHE for SG Aux. viz. 2 nos [1W + 1S] per Unit
- Total Six (6) nos. PHE for TG Aux. viz. 3 nos[2W + 1S] per Unit

The bidder shall include complete supplies of PHE's for TG Aux & SG Aux in his scope. Part supplies offered by the bidder shall disqualify the bidder's offer for the project.

**Bidders can offer the plates pressed in single/progressive manner as per their Plate suppliers manufacturing practice which shall be subjected to End Customer acceptance.**

**Sourcing of Plates shall be subjected to BHEL and End Customer acceptance.**

**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) in case of following Projects:

1. NTPC, 2X195 MW MUZAFFARPUR TPP

2.2 Passivated DM Water is circulated through various auxiliary coolers of TG & Boiler, in closed loop by means of pumps. This DM water picks up heat from different cooling equipments. 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.

**3.1.1 For NTPC, 2X195 MW MUZAFFARPUR TPP**

- Total Four (4) nos.PHE for SG Aux. viz. 2 nos [1W + 1S] per Unit
- Total Six (6) nos. PHE for TG Aux. viz. 3 nos[2W + 1S] per Unit

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

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<div><div><div>i) Suitable drain and vent connections for both primary (DMCW) and Secondary Water (Clarified Water) streams complete with isolation valves.</div><div>ii) Supporting arrangement complete with foundation plate channels, anchor bolts, nuts, sleeves, inserts etc.</div><div>iii) Lifting arrangement i.e., lifting lugs, eye bolts etc.</div><div>iv) Matching counter flanges with necessary bolts, nuts, and gaskets for all flanged terminal points, including for DMCW and ACW inlet/outlet nozzles.</div><div>v) Other accessories as required to make PHE's complete in all respects.</div><div>vi) Commissioning spares, if any.</div><div>vii) One Ratchet spanner per PHE is included in bidder's scope of supply .</div><div>viii) Matching piece (Reducer/Expander), with coatings (as required), to match the PHE nozzle connection with connecting pipe size as indicated in Data Sheet.</div><div>ix) Mandatory spares as applicable for each project as per data sheet A.</div></div><div><div>3.3</div><div>Finish paints for touch-up painting of equipment after erection at site in sealed containers.</div></div><div><div>3.4</div><div>Various drawings, datasheets, test reports/ certificates, instruction manuals for erection, operation and maintenance etc., as specified in Data Sheet-A.</div></div><div><div>3.5</div><div>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).</div></div><div><div>4.0</div><div>INSPECTION REQUIREMENTS</div></div><div><div>4.1</div><div>Inspection for “ Single/progressive 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.</div></div><div><div>4.2</div><div>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.</div></div><div><div>4.3</div><div>DP Test shall be conducted for 10% of HT plates. BHEL envisage witness of D.P. Test as follows:<div><div>a.</div><div>1% witness by Customer.</div></div><div><div>b.</div><div>2% witness by BHEL.</div></div><div>However during Contract Stage above percentage may vary from 1% to 10% for Customer &amp; from 2% to 10% for BHEL without any commercial implication. However, in case of defect, entire lot shall be tested &amp; only defect free plates shall be accepted.</div></div></div><div><div>4.4</div><div>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.</div></div><div><div>4.5</div><div>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.</div></div><div><div>4.6</div><div>100% PMI Inspection for material grade of PHE Heat Transfer plates shall be from third party like TUV/Lloyd &amp; certificate shall be submitted for review of BHEL.</div></div><div><div>4.7</div><div>BHEL reserves the right to conduct random &amp; independent PMI inspection on PHE's Heat</div></div></div>			



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Transfer plates to ascertain the plate material.

- 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 by White Light Scanning shall be from third party like TUV/Lloyd and certificate shall be submitted for BHEL's review. 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 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.

**6.0 SPARES :**

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



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**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.

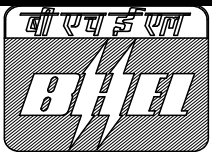
- a) Compliance certificate as enclosed in Volume III
- b) Schedule of Deviations if any.
- c) Guarantee Schedule.
- d) Schedules of Price & Unit Price for each project.
- e) GA Drg. of PHE indicating all-important details for Layout purpose, withdrawal space required for plates, weight of assembly, nozzle & matching piece details etc.
- f) Confirmation of plate area of the offered model, duly endorsed from the Head of Engg./R&D of Principal supplier of the plate.
- g) Schedule of declaration.
- h) Document as listed in specific technical PQR.
- i) Heat Transfer Area calculations for the PHE's.

7.1 Other Drawings/ documents as per Data Sheet-C, etc shall be submitted by successful bidder after the award of contract as per the distribution schedule enclosed as annexure 1 for respective projects.

**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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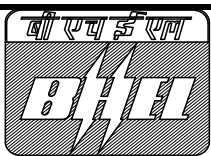
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**SECTION - D**

**PLATE HEAT EXCHANGER**

**STANDARD TECHNICAL SPECIFICATION**

- **DATA SHEET A**
- **DATA SHEET C**
- **STANDARD QUALITY PLAN**



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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.

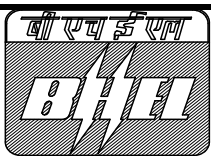
2.02.00 In case of any conflict between the above codes/ standards and this specification, the latter shall prevail and in case of any further conflict in the matter, the interpretation of the specification by the Engineer shall be final and binding

**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. Vibration, noise, mechanical and thermal stresses shall be kept within allowable units



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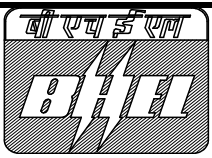
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specified by relevant codes/ standards in design. Due attention shall be given to *case of maintenance, repair and cleaning*.

- 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 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, 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.
- 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 but shall in no case be less than 0.6 mm. 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.

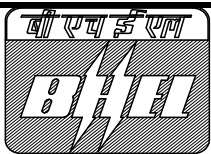
Each Plate shall be numbered in sequence. The number shall be marked by indelible ink on the plate to permit easy reassembly. The plates shall be pressed from one piece. They shall be pressed in single/ progressive manner.

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.

The upper carrying bar and lower guide bar shall be rigid in construction without any risk of sagging or buckling, and shall facilitate easy guiding of the plates.





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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.

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.

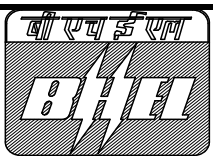
4.02.00 Plate heat exchanger shall be equipped with suitable lifting lugs/ eyebolts to facilitate handling during erection and maintenance.

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 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.

**TITLE:****STANDARD TECHNICAL  
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EXCHANGERS****SPECIFICATION NO. PE-TS-358-179-N001****VOLUME: II B****SECTION: D****REV: 04****DATE: 10.01.2012****SHEET: 6 OF 8****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.

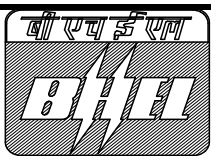
6.01.04 Qualification of welding procedures and welders shall be as per ASME B&PV Code, Section-IX/applicable code.

**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.

6.02.03 Minimum 10% of the 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 10% plates, the whole lot shall be tested and plates without defects only shall



**TITLE:**

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EXCHANGERS**

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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.

6.02.04 100% of the 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.

**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:**

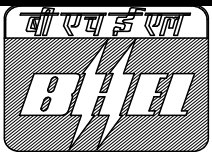
6.04.01 All materials for various components of frame assembly viz. frame plate, pressure plate, carrying bar, guide bar, tightening/ clamping bolts and nuts etc., shall be of tested quality and test certificates for chemical composition and physical properties shall be furnished.

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.

**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



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**SHEET: 8 OF 8**

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.

	<b>TECHNICAL SPECIFICATION FOR PLATE HEAT EXCHANGER</b>			
	<b>DATASHEET - A Rev.-00</b>			
	SL. NO.	DESCRIPTION	UNIT	DATA/ PARTICULARS
				<b>2X195MW MUZAFFARPUR TPP</b>
1.0	General			(SG AUX.) (TG AUX.)
1.1	Number of Plate Heat Exchanger	Nos	Four nos(4) viz Two (2) nos. per unit	Six nos(6) viz Three (3) nos. per unit
1.2	Arrangement		2 x 100% per unit	3 x 50% per unit
1.3	Location		Indoor	Indoor
1.4	Primary side (Hot) Fluid		Passivated DM water (Ref enclosed water analysis)	Passivated DM water (Ref enclosed water analysis)
1.5	Secondary side (Cold) fluid		Cooling Water (Ref enclosed water analysis )	Cooling Water (Ref enclosed water analysis )
1.6	Connecting Pipe size	(Primary Side)	NB	350
		(Secondary Side)	NB	350
2.0	Design			
2.1	Design Pressure		Kg/cm <sup>2</sup> (g)	12
2.2	Operating Pressure	(Primary Side)	Kg/cm <sup>2</sup> (g)	8.9
		(Secondary Side)	Kg/cm <sup>2</sup> (g)	3.4
2.3	Mechanical Design Temp.		°C	60
2.3	Heat Transfer per Sq.Mtr. Of Heat Transfer Plate		Kcal/Hr./m <sup>2</sup>	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 <sup>3</sup> /hr	685
		(ACW Side)	M <sup>3</sup> /hr	685
3.2	Inlet temperature	(DMCW Side)	°C	44.5
		(ACW Side)	°C	36
3.3	Outlet temp	(DMCW Side)	°C	38
		(ACW Side)	°C	42.5
3.4	* Allowable pressure drop across heat exchanger from inlet to outlet in fouled conditions at design flow	(DMCW Side)	MWC	7
		(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.			
4.0	Additional HT plates on Design Plates		%	NIL
5.0	Heat Transfer Coefficient/Margin			
5.1	Overall fouling resistance		Hr m <sup>2</sup> 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 316
6.2	Plate Gasket			Nitrile Rubber
6.3	Compression/ Pressure plates			Carbon Steel as per IS 2062 Gr. B, Epoxy Paint
6.4	Guide Rails/ bar			IS 2062 with stainless steel cladding
6.5	Support Beam/ column			Carbon Steel as per IS 2062 Gr. B, Epoxy Paint
6.6	Nozzle			Carbon Steel as per IS 2062 Gr. B
6.7	Nozzle flanges			Carbon Steel as per IS 2062 Gr. B


		TECHNICAL SPECIFICATION FOR PLATE HEAT EXCHANGER			
		DATASHEET - A      Rev.-00			
SL. NO.	DESCRIPTION	UNIT	DATA/ PARTICULARS		
			2X195MW MUZAFFARPUR TPP		
6.8	Flange/ Counter flanges		Carbon Steel as per IS 2062 Gr. B	Carbon Steel as per IS 2062 Gr. B	
6.9	Tie Bolts & Nuts		IS-1367 or equivalent	IS-1367 or equivalent	
6.10	Nozzle flange bolt and nut		SA 193 B7/ SA 194 2H	SA 193 B7/ SA 194 2H	
6.11	Nozzle flange gasket		3mm wire inserted Red Rubber	3mm wire inserted Red Rubber	
6.12	Name Plate		SS- 316	SS- 316	
6.13	Painting		All surface other than stainless steels shall be epoxy painted (Total DFT = min. 200 µm)		
	External Surface				
	a.) Surface Preparation				
	b.) Primer				
	c.) Intermediate				
	d.) Final Paint				
7.0	Extra Carrying capacity to be provided on frame assembly.	%	25	25	
8.0	Mandatory Spares				
8.1	Plates		2% for each type.	NIL	
8.2	Gaskets		5% of total requirement of each type & size.	NIL	
8.3	Fasteners		NIL	NIL	
8.4	Valve		NIL	NIL	
8.5	Definitions Regarding %	-	Quantity shall be calculated for % supply of total quantity for all units (if in fraction , round off to next higher whole no.)	NIL	
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's 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	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.				

CLAUSE NO.	PROJECT SYNOPSIS			
				ANNEXURE -III (Page 1 of 5)
	COOLING WATER ANALYSIS			
	Constituent	as	mg per litre	
	1. Calcium	CaCO3	462	
	2. Magnesium	CaCO3	297.5	
	3. Sodium	CaCO3	297.5	
	4. Potassium	CaCO3	35	
	5. Chloride	CaCO3	252	
	6. Sulphate	CaCO3	157.5	
	7. Carbonate & Bi-Carbonate	CaCO3	682.5	
	8. Silica	SiO2	2	
	9. Iron	Fe	Nil	
	10. pH Value	--	8	
	11. Turbidity	NTU	40	
	Note : The C.W. system is expected to operate at aboutt 3.5 cycles of Concentration.			
MUZAFFARPUR THERMAL POWER PROJECT STAGE-II (2X195 MW) MAIN PLANT PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI PART-A BID DOCUMENT NO.: CS-0350-108-2		CHAPTER-A0 PROJECT SYNOPSIS  PAGE 11 OF 15

# DM WATER ANALYSIS

Applicable for ALL Projects (PHE-Primary Side)

ANNEXURE - A-9

CLAUSE NO.	PROJECT INFORMATION			
	ANALYSIS OF DM WATER TO BE USED			
	AS			
	PRIMARY FLUID FOR PHEs OF ALL THE PROJECTS			
	S.No.	Characteristics	-	Value
	i)	Silica (Max.)	-	0.02 ppm as SiO <sub>2</sub>
	ii)	Iron as Fe	-	Nil
	iii)	Total hardness	-	Nil
	iv)	pH value	-	CORRECTED TO 8.5-9.5
	v)	Conductivity excluding the effects of free CO <sub>2</sub>	-	Not more than 0.1
APPLICABLE FOR ALL PROJECTS		TECHNICAL SPECIFICATIONS SECTION-VI PART-A		PROJECT SYNOPSIS
				PAGE 1 OF 1





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

**SPECIFICATION NO. PE-TS-358-179-N001**

**VOLUME II B**

**SECTION D**

**REV. NO. 0**

**DATE 10/01/12**

**SHEET 1 OF 1**

**DATA Sheet-C**

Drawings / documents distribution schedule to be followed by successful bidder:

1.0 Within 2 weeks from the date of LOI, the successful bidder shall submit following drawings/ documents.

- a) Data Sheet-B duly filed in along with heat transfer calculations.
- b) G.A./ installation drawings, indicating principal dimensions and heights of equipment being supplied, size and location of various nozzles, connection supporting arrangement, withdrawal space & scope of supply etc.
- c) Foundation arrangement drawings, showing load data on supports, size and location of anchor bolts etc.
- d) Quality Plan.
- e) Area & Heat Load Calculations.
- f) Various performance curves as listed in our specification.
- g) Cross-Sectional drawing indicating bill of quantities and materials of construction.
- h) Performance test procedure.

2.0 Within the stipulated time period as per vendor's drawings/ documents schedule, the following shall be submitted but not later than one month before 1<sup>st</sup> dispatch.

- a) Drawings of components & details as deemed necessary.
- b) Instruction manual for erection, operation & maintenance.
- c) Storage instruction.


3.0 Before despatch of the equipment the bidder shall furnish the following.

- a) Material test certificates.
- b) Shop test reports & certificates.


4.0 Distribution of drawings / documents for all projects:

The successful bidder, after the award of the contract shall furnish the drawings/ documents as per the following distribution schedule.


Sl. No.	Type of Document	No of Hard copies	No. of Soft copies
1	Documents submitted for Approval	18 Nos.	2 Nos.
2	Final Distribution(Approved Documents)	18 Nos.	2 Nos.
3	O&M Manuals	18 Nos.	2 Nos.
4	As built drawings	18 Nos.	2 Nos.


		<b>STANDARD QUALITY PLAN</b>  SHEET OF _____		CUSTOMER:		PROJECT TITLE:		SPECIFICATION NO. :						
				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.	
<b>1.0 RAW MATERIAL INSPECTION</b>														
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 <b>See Remark 1</b>
		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 <b>See Remark 1</b>
		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	

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


		<b>STANDARD QUALITY PLAN</b>  SHEET OF _____		CUSTOMER:		PROJECT TITLE:		SPECIFICATION NO. :						
				BIDDER/VENDOR:		QUALITY PLAN NO.:		SPECIFICATION TITLE :						
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					2/3	1				D*	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	

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SIGNATURE					REVIEWED BY	APPROVED BY	APPROVAL SEAL

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				BIDDER/VENDOR:		QUALITY PLAN NO.:		SPECIFICATION TITLE :						
				SYSTEM:		ITEM: PHE		SECTION :						
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					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	See Remark 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	-	
				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	-	
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	-	
		<b>LEGEND:</b> * 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		

		<b>STANDARD QUALITY PLAN</b>  SHEET OF _____		CUSTOMER:		PROJECT TITLE:		SPECIFICATION NO. :						
				BIDDER/VENDOR:		QUALITY PLAN NO.:		SPECIFICATION TITLE :						
				SYSTEM:		ITEM: PHE		SECTION :						
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					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	<b>FINAL INSPECTION</b>													
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.

<b>LEGEND:</b> * 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"		<b>Cust. Logo</b>  <b>FOR CUST. USE</b>	DOC. NO.:		REV.	CAT.
			REVIEWED BY		APPROVED BY	APPROVAL SEAL
MANUFACTURER/ SUB-SUPPLIER  SIGNATURE		MAIN-SUPPLIER				

		<b>STANDARD QUALITY PLAN</b>  SHEET OF		CUSTOMER:		PROJECT TITLE:		SPECIFICATION NO. :						
				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				D*	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		
<b>REMARKS:-</b>														
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(Refer Annexure –A ).													

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

**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 porion below**

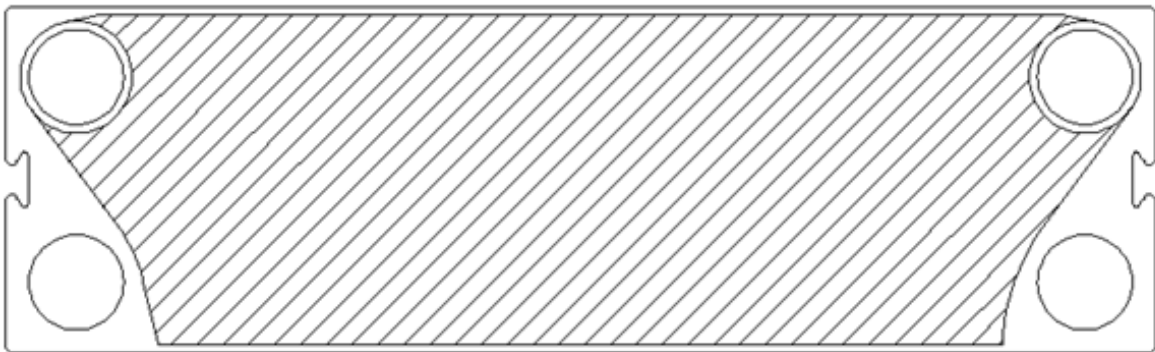


Fig. 1: Wetted Surface Area for Parallel Connection

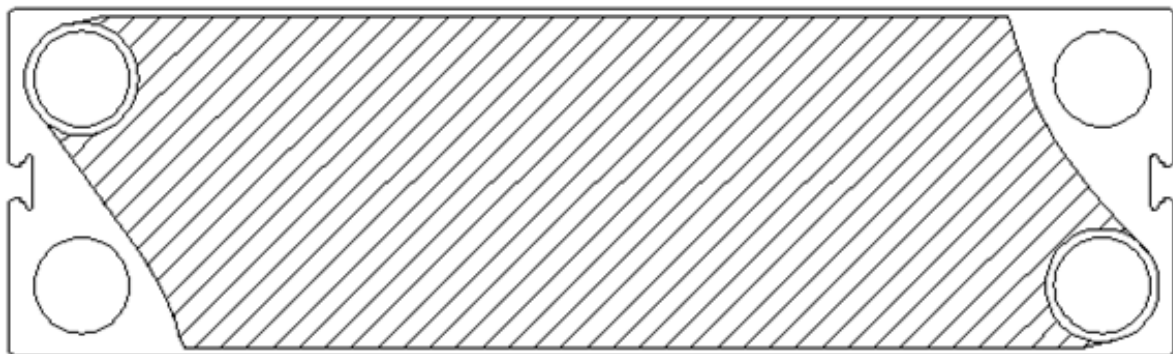


Fig. 2: Wetted Surface Area for Diagonal Connection