UPRVUNL

1 X 660 MW PANKI TPS EXTENSION

TECHNICAL SPECIFICATION

PLATE HEAT EXCHANGERS

Specification No.: PE-TS-426-179-N001 (REV 01)

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

CONTENTS

This Technical Specification consists of three Sections:

Notes:

1) For detailed list of documents to be submitted by bidder in their technical offer, please refer cl. no. 10.00.00 of Section-IIA.

2) For detailed list of documents to be submitted by vendor after award of contract, please refer Datasheet-C of Section-IIA.

3) In case there is conflict in different clauses of specification, most stringent clause (as decided by BHEL / end customer) shall be followed, if no specific deviation is taken by bidder and accepted by BHEL during tender stage in that regard.

SECTION I

IA SPECIFIC TECHNICAL REQUIREMENTS

IB DATASHEET – A

1.0 GENERAL:

1.1 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 mandatory spares (as applicable), accessories, commissioning & erection spares (if any), counter flanges with nuts, bolts, gaskets and coatings (wherever necessary), including special tools & tackles (if any), including site PG test (as applicable) as mentioned in this specification for 1x660 MW Panki TPS Extension.

The Plate Heat Exchangers complete with all accessories including special tools and tackles (if any) shall conform to the Data Sheet-A (Section IB) and other requirements of section IIA. In addition, the requirements of this Section IA including Customer Specification attached at Appendix 1 (as applicable) shall also be complied with.

1.2 The bids shall be evaluated as per NIT. Ordering shall be done as per NIT.

1.3 Bidder to quote for items as per price schedule attached in NIT.

1.4 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, work or material, which in his opinion is not in conformity with the duty requirements.

Note: Type of PHEs have been detailed in Data Sheet-A, Section-1B. The bidder shall include complete supplies in his scope. Part supplies offered shall disqualify the bidder's offer. Evaluation shall be combined and further details shall be indicated in NIT.

2.0 SPECIFIC REQUIREMENTS:

2.1 Design heat load of plate type heat exchangers and Inlet & Outlet temperatures of the Plate type heat exchangers on the primary and secondary side to be demonstrated at site.

Pressure drop across the Plate type heat exchanger on the primary & secondary water circuit to be demonstrated at site.

PG test at site (if applicable) be conducted as per clause 8.02.00 of Section-IIA. Bidder to quote Unit Rate for PG test accordingly.

2.2 The Heat transfer plate area measurement procedure and packing procedure indicated at Section-IIA are only for reference. Project specific procedures shall be submitted by the bidder during detailed engineering for approval.

2.3 Following to be complied by the bidder:

a) Supplier to submit detailed 'Bill of Material' (BoM) at the time of drawing/document

submission after placement of PO. Each item of the BoM to be uniquely identified with item code no. or item serial no.

b) Supplier to ensure that all items which will find separate mention in the packing list are covered in this detailed BoM.

c) Supplier to give following undertaking in the BoM:

"The BoM provided herewith completes the scope (in content and intent) of material supply under PO no.----------, dated ----------.
Any additional material which may become necessary for the intended application of the supplied items(s)/package will be supplied free of cost in most reasonable time."

2.4 Velocity in the PHE plates shall be so chosen such that sufficient turbulence should be maintained so as to prevent any deposition on the plate surface.

2.5 All nozzles shall be ' built-in type' and shall have a raised face.

3.0 The drawing / document submission schedule shall be as per NIT. MDL shall be as follows:

PACKAGE	BHEL DRG NO	DRG TITLE
PLATE HEAT EXCHANGERS (PHE)	PE-V5-426-179-N001	Technical Data sheet of PHE
	PE-V5-426-179-N002	GA drawing of PHE
	PE-V5-426-179-N003	Thermal sizing calculation of PHE
	PE-V5-426-179-N005	QAP of PHE
	PE-V5-426-179-N004	Performance curves of PHE
	PE-V5-426-179-N006	O&M MANUAL for PHE
	PE-V5-426-179-N007	PG TEST PROCEDURE -PHE (If Applicable)

Drawings submitted shall be complete in all respects with revised drawing submitted incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays to bidder's account. For any clarification/ discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL for across the table discussions/ finalizations/ submissions of drawings.

Appendix 1

(Customer Specification)

Section M4 : Equipment Cooling Water System

	TEST / CHECKS ITEM / COMPONENTS	Material Test	WPS/PQR/Welder Qualification	DPT/MPI	Assembly Fit Up	Visual & Dimensional Check	UT	RT	Hydraulic / Water Fill	Balancing	Type Test	Performance Test	Other Test
A	**PLATE TYPE HEAT EXCHANGER**		Y	Y[3]	Y	Y			Y				
A.1	Heat Transfer Plates	Y[1]		Y[2]		Y	Y[5a]						Y 7
A.2	Gaskets	Y				Y							
A.3	Cover Plates (Front & Rear)	Y[1]				Y	Y[5a]						
A.4	Tie Rods	Y[1]		Y[4]			Y[5b]						
B	**HORIZONTAL / VERTICAL CENTRIFUGAL PUMP**				Y	Y						Y 10	
B.1	Casing	Y[1]		Y[4]		Y			Y				
B.2	Impeller	Y[1]		Y[4]		Y				Y 9			
B.3	Shaft	Y[1]		Y		Y	Y[5b]			Y 9			
B.4	Fabricated Components	Y[1]	Y	Y[3]	Y	Y	Y[5a]	Y 6	Y 8				

Notes:	
1.	One per heat / HT batch
2.	DP Test shall be conducted for 10% of the lot of HT plates. However, in case of any defect, entire lot shall be tested and only defect free plates shall be accepted
3.	100% DP Test shall be conducted on butt welds and 10% DPT on fillet weld after final run
4.	100% DPT shall be carried out on machined surfaces
5a.	UT shall be done on plates with thickness 25 mm or above
5b.	UT shall be done on shaft / tie rod with diameter 50 mm or above
6.	RT shall be conducted on butt joints having plate thickness above 10 mm. Quantum of RT shall be based on pressure rating
7.	Each Plate after pressing shall be subject to either of the following tests, as per Manufacturer Practice a) Light Box Test b) Vacuum Test c) Air Chamber Test
8.	All pressure retaining parts shall be hydrostatically tested at 200% of pump rated head or 150% of shut – off head, whichever is higher, for at least 30 minutes. No leakage is allowed

	TECHNICAL SPECIFICATION			**Technical specification no**	**PE-TS-426-179-N001 (Rev 01)**
	PLATE HEAT EXCHANGER			**Section**	**IB**
	DATASHEET - A			**Rev**	**01**
	1X660 MW PANKI TPS			**Date**	**04-06-2021**
	PHE DESCRIPTION			**DMCW-TG PHE**	**DMCW-SG PHE**
1.0	**General**				
1.1	**Number of Plate Heat Exchanger**		Nos	Three (3) nos	Two (2) nos
1.2	**Arrangement**			3X50% configuration	2X100% configuration
1.3	**Location**			Indoor	Indoor
1.4	**Primary side (Hot) Fluid**			Passivated DM water (Refer enclosed water analysis)	Passivated DM water (Refer enclosed water analysis)
1.5	**Secondary side (Cold) fluid**			Clarified water (Refer enclosed water analysis)	Clarified water (Refer enclosed water analysis)
1.6	**Connecting Pipe size**	(Primary Side)	NB	700	350
		(Secondary Side)	NB	700	400
1.7	**Maximum permitted Length of the PHE**		mm	5000 mm (excluding reducer)	5000 mm (excluding reducer)
2.0	**Design**				
2.1	**Design Code**			Latest IS/BS/DIN/ASTM Standards	Latest IS/BS/DIN/ASTM Standards
2.2	**Design Pressure**		Kg/cm^2 (g)	10	12
2.3	**Operating Pressure**	(Primary Side)	Kg/cm^2 (g)	6.0 to 7.0 Kg/sq. cm(g)	8.0 to 9.0 Kg/sq. cm(g)
		(Secondary Side)	Kg/cm^2 (g)	2.5 to 3.5 Kg/sq. cm(g)	2.5 to 3.5 Kg/sq. cm(g)
2.4	**Mechanical Design Temp.**		^oC	60	60
2.5	**Heat Transfer per Sq.Mtr. Of Heat Transfer Plate**		$Kcal/Hr./m^2$	To be decided by bidder	To be decided by bidder
2.6	**Specific Heat of Fluid**	**(Primary Side)**	Cal/gmDeg.C	1	1
		(Secondary Side)	Cal/gmDeg.C	1	1
2.7	**Density of Fluid**	**(Primary Side)**	gm/cc	1	1
		(Secondary Side)	gm/cc	1	1
3.0	**Guaranteed Performance Requirements for each Heat Exchangers in fouled condition:**				
3.1	**Flow rate**	(DMCW Side)	M^3/hr	2225	665
		(ACW Side)	M^3/hr	2450	735
3.2	**Inlet temperature**	(DMCW Side)	^oC	44.4	44.5
		(ACW Side)	^oC	36	36
3.3	**Outlet temp**	(DMCW Side)	^oC	39	39
		(ACW Side)	^oC	41	41
3.4	*** Allowable pressure drop across heat exchanger from inlet to outlet in fouled conditions at 1.1 times of design flow**	(DMCW Side)	MWC	10	10
		(ACW Side)	MWC	10	10
	*** 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. 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.**				
4.0	**Additional HT plates on Design Plates**		%	5%	5%
5.0	**Heat Transfer Coefficient/Margin**				
5.1	**Overall fouling resistance (minimun)**		Hr m2deg C/Kcal	0.00008	0.00008

	TECHNICAL SPECIFICATION			**Technical specification no**	**PE-TS-426-179-N001 (Rev 01)**
	PLATE HEAT EXCHANGER			**Section**	**IB**
	DATASHEET - A			**Rev**	**01**
	1X660 MW PANKI TPS			**Date**	**04-06-2021**
	PHE DESCRIPTION			**DMCW-TG PHE**	**DMCW-SG PHE**
5.2	**Minimum corrosion allowance on heat exchanger parts of carbon steel (e.g. pressure parts,nozzles,sliding channel and frame) (refer note 1)**		mm	1.6	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	SS-316
6.2	**Plate Gasket**			Nitrile rubber, 65 ± 5 % shore hardness	Nitrile rubber, 65 ± 5 % shore hardness
6.3	**Compression/Fixed/Frame/Movable Pressure plates**			Carbon Steel, IS-2062, Gr.B, Epoxy painted	Carbon Steel, IS-2062, Gr.B, Epoxy painted
6.4	**Guide Rails/ bar**			Carbon Steel, IS-2062, Gr.B, with SS Cladding	Carbon Steel, IS-2062, Gr.B, with SS Cladding
6.5	**Support Beam/ column**			Carbon Steel, IS-2062, Gr.B, Epoxy painted	Carbon Steel, IS-2062, Gr.B, Epoxy painted
6.6	**Nozzle (Reducer/Expander)**			Carbon steel IS 2062, Gr. B, Epoxy Coated	Carbon steel IS 2062, Gr. B, Epoxy Coated
6.7	**Nozzle flanges**			Carbon Steel IS 2062 (Confirming to ANSI B 16.5 class, Min.-150 lb) Epoxy Coated	Carbon Steel IS 2062 (Confirming to ANSI B 16.5 class, Min.-150 lb) Epoxy Coated
6.8	**Flange/ Counter flanges**			Carbon Steel as per IS 2062 Gr. B (Confirming to ANSI B 16.5 class, Min.-150 lb) Epoxy Coated	Carbon Steel as per IS 2062 Gr. B (Confirming to ANSI B 16.5 class, Min.-150 lb) Epoxy Coated
6.9	**Tightening Bolts/Rods & Nuts**			IS-1367 Gr.8.8 or equivalent	IS-1367 Gr.8.8 or equivalent
6.10	**Nozzle flange bolts / nuts**			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**			AISI 316 18'-8' SS (3 mm thick)	AISI 316 18'-8' SS (3 mm thick)
6.13	**Wetted fasteners**			SS-316	SS-316
6.14	**Painting**				
	External Surface				
	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 (SA 2.5) etc shall be subjected to BHEL/Customer approval. For all the steel surfaces, a coat of epoxy resin based zinc phosphate primer of min thickness of 50 microns followed up with undercoat of epoxy resin based paint pigmented with Titanium dioxide with min thickness of 50 microns shall be applied. The top coat shall consist of two coats each of min 50 microns thickness of epoxy paint. Thus total thickness shall be minimum 200 microns.	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 (SA 2.5) etc shall be subjected to BHEL/Customer approval. For all the steel surfaces, a coat of epoxy resin based zinc phosphate primer of min thickness of 50 microns followed up with undercoat of epoxy resin based paint pigmented with Titanium dioxide with min thickness of 50 microns shall be applied. The top coat shall consist of two coats each of min 50 microns thickness of epoxy paint. Thus total thickness shall be minimum 200 microns.
	b.) Primer				
	c.) Final Paint				
7.0	**Extra Carrying capacity to be provided on frame assembly.**		%	25	25
8.0	**Spares**		**Unit of Measurement**		
8.1	**Heat Transfer Plates**		Lot	10% of each type & size	10% of each type & size
8.2	**Gaskets (All types)**		Lot	30% of total requirement of eacht type & size.	30% of total requirement of eacht type & size.

	TECHNICAL SPECIFICATION		**Technical specification no**	**PE-TS-426-179-N001 (Rev 01)**
	PLATE HEAT EXCHANGER		**Section**	**IB**
	DATASHEET - A		**Rev**	**01**
	1X660 MW PANKI TPS		**Date**	**04-06-2021**
	PHE DESCRIPTION		**DMCW-TG PHE**	**DMCW-SG PHE**
8.3	**Fasteners**	Lot	10% of each type & size	10% of each type & size
9.0	**Hydrotesting at Shop**			
9.1	**Hydrotesting Pressure**	Kg/cm2 (g)	1.5 times the design pressure	1.5 times the design pressure
9.2	**Duration of Hydrotesting**	Minutes	30	30
10.0	**Performance curves and figures to be furnished during contact stage**			
10.1	Primary side water outlet temperature vs. Secondary side water inlet temperature.			
10.2	Primary side water flow (80% to 115%) vs. Pressure drop and outlet temperature (Secondary side flow – 100%)			
10.3	Secondary side water flow (80% to 115%) vs. Secondary side pressure drop and primary side outlet temp (Primary side flow – 100%)			
10.4	Primary side water outlet temperature vs. Primary side inlet temp.			
10.5	Film heat transfer coefficient curve			
10.6	Correction Curves.			
11.0	**Minimum Standard requirement of the PHE to be offered by the bidder.**			
11.1	Minimum Corrosion allowance on thickness (as per ASME Sec. VIII Div. I)			
11.2	Metallurgy specified above is bare minimum . Equivalent or Superior materials suitable for fluid handled is also acceptable subject to Customer/BHEL approval.			
11.3	Plate thickness should be adequate to withstand all operating conditions but with Minimum plate thickness of 0.6 mm (No negative tolerance allowed in thickness specified). The plates shall be pressed from one single piece with the corrugation being smooth, uniform and identical for every plate.			
11.4	The plate Heat exchangers shall be single pass type. 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.			
11.5	Double sealing arrangement shall be provided at outer edge and around ports with the inter space between the seals vented to atmosphere in order to avoid inter-mixing of liquids in case of gaskets failure.			
11.6	Each Plate shall be numbered in sequence with the number marked by indelible ink on each plate to permit easy reassembly.			
11.7	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.			
11.8	Painting as specified at Sl. No. 6.14 above shall be subject to customer/BHEL approval during detailed engineering. No Price implication shall be admissible on account of this.			

DM WATER ANALYSIS

Applicable for ALL Projects (PHE - Primary Side)

ANNEXURE - A-9

CLAUSE NO.	PROJECT INFORMATION NTPC

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 SiO2
ii)	Iron as Fe	-	Nil
iii)	Total hardness	-	Nil
iv)	pH value	-	CORRECTED TO 8.5-9.5
v)	Conductivity excludingthe effects of free CO_2	-	Not more than. 0.1

ANNEXURE-I: CLARIFIED WATER ANALYSIS

S. No.	Description	Unit	Parameter
1	Physical characteristics		
	pH at 25^0C	-	7.59
	Turbidity	NTU	<15
	Conductivity	µs /cm	590
	Total Dissolved solids	ppm	285
	Total Suspended Solids	ppm	<15
2	Cations		
	Calcium Hardness	ppm as CaCO3	113.86
	Magnesium Hardness	ppm as CaCO3	40
	Sodium + Potassium	ppm as CaCO3	37.2
	Iron	ppm as CaCO3	0.3
	Total Cations	ppm as CaCO3	191.36
3	Anions		
	Bicarbonate	ppm as CaCO3	97
	Carbonate	ppm as CaCO3	0.34
	Hydroxyl	ppm as CaCO3	0.02
	Chlorides	ppm as CaCO3	27.1
	Sulphate	ppm as CaCO3	66.4
	Nitrate	ppm as CaCO3	0.5
	Total Anions	ppm as CaCO3	191.36
4	Carbon Di-oxide as CO_2	ppm	5.54
5	Dissolved Silica	ppm as SiO2	10.0
6	Colloidal Silica	ppm as SiO2	0.5

SECTION II

IIA STANDARD TECHNICAL SPECIFICATION STANDARD QUALITY PLAN

1.00.00 **GENERAL**

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

1.01.00 **SYSTEM DESCRIPTION**:

1.01.01 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 / Sea Water).

1.01.02 Passivated DM Water is circulated through various auxiliary coolers of TG/SG/Station Aux., 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.

1.01.03 The analysis of DM Water, Clarified /Sea Water (Auxiliary cooling water) to be handled by the Plate Heat Exchangers are attached as Annexure to Data Sheet-A.

1.01.04 A strainer of 2 mm size at ACW inlet lines of PHE is provided and backwashing of PHE's is not envisaged.

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 **SCOPE OF SUPPLY**:

3.01.00 The details of the Plate Heat Exchangers with the quantity, design parameters etc. to be supplied shall be as per Data Sheet-A enclosed at Section IB.

3.02.00 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 (Raw Water/ Sea Water as applicable) 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 & reducers/ expanders.

(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 for each type of PHE is included in bidder's scope of supply.

(ix) Matching piece (Reducer/Expander), with coatings (as required), to match the PHE nozzle connection with connecting pipe size at DMCW side/ ACW side as indicated in Data Sheet. In case of sea Water, Matching piece on ACW Side (Secondary) shall be flanged with coatings (as required for sea water application).

(x) Spares as applicable as per data sheet A at Section IB.

3.03.00 Finish paints for touch up painting of equipment after erection at Site in sealed containers.

3.04.00 Items though not specifically mentioned in the specification but needed to complete the equipment to meet the intent of specification, shall also be deemed to be included unless otherwise specifically mentioned in exclusions.

4.00.00 **EXCLUSIONS :**

The following are excluded from the bidder's scope:

4.01.00 Civil foundation works required for installation of the heat exchangers.

4.02.00 Piping, valves etc., on the external circuit of both primary and secondary water streams.

4.03.00 Erection & Commissioning of equipment at site.

5.00.00 **DESIGN AND CONSTRUCTION:**

5.01.00 **General Requirements:**

5.01.01 Unless otherwise necessary manufacturer's standard and proven models of the plate heat exchanger shall be supplied.

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

5.01.03 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).

5.01.04 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.

5.01.05 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.

5.01.06 No back wash for the heat exchangers is envisaged.

5.02.00 **Performance Requirements:**

5.02.01 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.

5.02.02 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.

5.02.03 In the event of failure to meet the above stipulated performance requirements, the equipment will be outrightly rejected.

5.03.00 **Construction of Heat Exchanger:**

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

5.03.02 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 interspace 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.

5.03.03 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 Datasheet-A. Flanges shall be as per ANSI B 16.5 or equivalent. Thickness of pressure and frame plates shall be as per ASME Sec. 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.

5.03.04 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 or sagging or buckling, and shall facilitate easy guiding of the plates.

5.03.05 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 all the nozzle connections. The nozzle sizes of primary / secondary streams of PHEs shall be of adequate size within acceptable range of velocity. The size selection shall be subject to approval in the event of order.

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

5.04.00 **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.

5.05.00 **Foundation And Lifting Arrangements:**

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

5.05.02 Plate heat exchanger shall be equipped with suitable lifting lugs/ eye-bolts to facilitate handling during erection and maintenance.

6.00.00 **PAINTING:**

6.01.00 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 blasing.

6.02.00 All exterior surfaces of PHEs shall be sand / shot blasted, painted with primer and finish coated with coal tar based epoxy coating of min. 250 microns thickness. Colour shade etc. shall be subject to BHEL / customer approval.

7.00.00 **SHOP INSPECTION AND TESTS:**

7.01.00 **General:**

7.01.01 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.

7.01.02 All materails 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.

7.01.03 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.

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

7.02.00 **Heat Transfer Plates:**

7.02.01 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.

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

7.02.03 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. Plates cleaning agent, liquid penetrant and developer shall not contain any halogen. Procedure for DP test shall be subjected to purchaser's approval. Quantum of check shall be subject to customer's/purchaser's approval in the event of order.

7.02.04 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 (Llyods, TUV or equivalent). The plates without defects only shall be accepted. Procedure for Light box test shall be subjected to purchaser's approval. Quantum of check shall be subject to customer's/purchaser's approval in the event of order.

7.02.05 **Inspection Requirements**

(i) Inspection for "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.

(ii) Minimum requirement for quality Plan shall be as per quality plan attached in the Section IIA of the specification. 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.

(iii) Heat transfer area for the PHE shall be measured by White light scanning / similar method during contract stage to ascertain the correctness of heat transfer area.

Bidder to note that Heat Transfer Area measured by White Light Scanning should not have negative tolerance more than 3% w.r.t to the heat transfer area indicated by bidder. 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.

7.03.00 **Gaskets :**

7.03.01 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.

7.03.02 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.

7.03.03 Visual and dimensional check on a sampling basis shall be done. Plates and gaskets assembled together, will be inspected for proper assembly.

7.04.00 **Frame Assembly:**

7.04.01 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.

7.04.02 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.

7.05.00 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.

7.06.00 **Nozzle and Flanged Connections:**

All materails for various nozzles, flanges, gaskets, nuts, bolts etc., shall be of tested quality and correlating test certificates for chemical and mechanical properties shall be furnished. These shall be checked for the edge preparation, fit up, orientation and satisfactory working with matching parts.

7.07.00 **Dimensional Checks**:

Dimensional checks of various components of plate heat exchanger, plate pack length etc., shall be carried out as per assembly drawings approved by BHEL.

7.08.00 **Hydrostatic Test :**

Plate heat exchanger shall by hydrostatically tested at a pressure of 1.5 times the design pressure. Pressure shall be applied first to both the sides of the plate at the same time, then only to one side and finally only to other side. Pressure shall be maintained for a minimum period of 30 Minutes for each of the three cases above and for such additional time as may be necessary to conduct the examination, for leakage. The examination shall be performed on all joints, connections and regions of high stress. Fluorescent dye shall be used during the test for ease of leak detection. There shall be no structural damage deformation of the plates.

8.00.00 **PERFORMANCE GUARANTEE AND TESTING AT SITE:**

8.01.00 **Performance Guarantee**

8.01.01 After completion of erection at site, performance test will be conducted to ensure that the plate heat exchanger operation meets the specified requirements. Rectification of all defects shall have to be done by the supplier at no extra cost to the purchaser. However the purchaser reserves the right to reject the equipment/ parts not meeting the requirement if the deficiency still persists.

8.01.02 The Plate Heat Exchanger shall be guaranteed to meet the performance requirements as given in Data Sheet-A of Section-IB and also for trouble free operation after commissioning.

8.02.00 **PG Testing at Site**

8.02.01 The guaranteed performance figures of the plat heat exchangers shall be proved by the supplier during the performance testing at site (as applicable). If the results of these tests show the non-performance of the heat exchanger to meet the guaranteed values, the supplier shall modify the heat exchanger as required to enable it to meet the guarantees.

Even If PG test is not envisaged for any project, in the event of performance shortfall at site or if insisted by customer, performance parameters (Flow, Temperature rise & Pressure drop) are to be demonstrated at site by bidder without any cost implication to BHEL.

8.02.02 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.

8.02.03 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.

8.02.04 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.

9.00.00 **QUALITY ASSURANCE & QUALITY PLAN:**

9.01.00 The Plate Heat Exchanger to be supplied shall have assured quality and workmanship.

9.02.00 Typical quality plan is enclosed in section-IIB for guidance. The bidder shall comply with these minimum requirements and shall furnish his own quality plan for approval. The quality plan shall be subjected to customer's / purchaser's approval in the event of order without any cost implication.

10.00.00 **DRAWINGS, DATA & INFORMATION TO BE SUBMITTED ALONG WITH THE OFFER:**

10.01.00 Compliance certificate (duly signed and stamped).

10.02.00 Guarantee Schedule (duly signed and stamped).

10.03.00 Thermal sizing calculations (only for reference and shall be reviewed during detailed engineering).

10.04.00 GA Drg. of PHE indicating all-important details for Layout purpose, withdrawal space required for plates, weight of assembly, nozzle & matching piece details etc. (only for reference and shall be reviewed during detailed engineering).

10.05.00 Deviation Schedule (as per NIT format; in case of nil Deviation, mention "No Deviation" in the schedule and submit).

11.00.00 **DRAWINGS, DATA & INFORMATION TO BE SUBMITTED AFTER THE AWARD OF CONTRACT:**

The drawings, data and other documents as required in Data Sheet-C shall be furnished after the award of contract.

12.00.00 **In the event of Contradictions between Section I and Section-II of the Specification, the requirements of Section-I shall prevail over the Section-II.**

1.00.00 **DRAWINGS, DATA AND INFORMATION TO BE SUBMITTED AFTER THE AWARD OF CONTRACT**

After the award of contract, the following drawings, data and information is to be submitted for review/ approval of BHEL as per the distribution schedule given in the enquiry.

1.01.00 Within 2 (two) weeks of the date of LOI, the following shall be submitted.

1.01.01 Data Sheet-B duly revised conforming to accepted bid.

1.01.02 Final versions of the following drawings to enable BHEL to design foundations and structures and to finalise the layout.

a) General Arrangement/ Installation drawings indicating principal dimensions, and heights of equipment being supplied, size and location of various nozzles, connections, supporting arrangement, withdrawal space, bill of quantities and materials of construction and scope of supply etc.

b) Foundation arrangement drawings showing load data on support, size and location of anchor bolts etc.

1.01.03 Sizing and calculations related to PHE/plates.

1.01.04 Performance curve and figures as indicated in Data Sheet-A (for both clean and fouled conditions).

1.01.05 Quality Plan for PHE.

1.01.06 PG Test procedure (as applicable).

1.02.00 Within the stipulated time period the following drawing/ document shall be submitted:

1.02.01 Drawings of components and details as deemed necessary.

1.02.02 Material Test Certificates.

1.02.03 Shop Tests Reports and Certificates.

1.02.04 Write-up and Instruction Manuals for Erection, Operation and Maintenance.

1.02.05 Storage Instruction.

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO : PE-TS-999-179-N001, R01	DATE: 02/05/18
	CUSTOMER :		QP NO.: PE-QP-999-179-N004	DATE: 15/02/2020
	PROJECT:		PO NO.:	DATE:
	ITEM: PLATE HEAT EXCHANGER	SYSTEM: DMCW/ACW	SECTION:	SHEET 1 of 6

SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	D	**			
					M	C/ N					M	C	N	
1.0	RAW MATERIAL INSPESTION													
1.1	Frame Plates & Pressure Plates, Counter Flanges, Connection Lining Material, Top And Bottom Carrying Bar.	Physical Properties	MA	Physical Test	1/ Heat	1/ Heat	App. Drg / Data Sheet	Relevant material Std.	Mill TC Or Lab Test Report	√	P,V	V	V	If co-related mill TCS are not available then check testing carried out by NABL lab
		Chemical Properties	MA	Chemical Analysis	1/ Heat	1/ Heat	App. Drg / Data Sheet	Relevant material Std.	Mill TC Or Lab Test Report	√	P,V	V	V	If co-related mill TCS are not available then check testing carried out by NABL lab
		Dimensions	MA	Measurement	100%	100%	Approved Drawings	Approved Drawings	Inspection Reports	√	P,V	V	V	
		Workmanship And Finish	MA	Visual	100%	100%	Approved Drawings	Approved Drawings	Inspection Reports	√	P,V	V	V	
		Lamination (Applicable For Frame And Pressure Plate Only)	CR	Ultrasonic Test	100%	100%	SA 435	SA 435	Inspection Reports	√	P,V	V	V	Applicable for plate thickness more than 25 mm only
1.2	Heat Transfer (HT) Plates/Coils	Physical Properties	MA	Physical Test	1/ Heat	1/ Heat	App. Drg. / Data Sheet	App. Drg. / Data Sheet	Mill TC Or Lab Test Report	√	P,V	V	V	**See Remark 1**
		Chemical Properties	MA	Chemical Analysis	1/ Heat	1/ Heat	App. Drg. / Data Sheet	App. Drg. / Data Sheet	Mill TC Or Lab Test Report	√	P,V	V	V	**See Remark 1**
		Dimensions	MA	Measurement	100%	Sample	Approved Drawings	Approved Drawings	Inspection Reports	√	P,V	V	V	

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	19/2/20	NIKHIL DUBEY	Checked by:	19.02.20	MOHIT KUMAR		
Reviewed by:	19/2/2020	VISHAL KR. YADAV	Reviewed by:	19/2/2020	RITESH KR. JAISWAL		

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO : PE-TS-999-179-N001, R01	DATE: 02/05/18
	CUSTOMER :		QP NO.: PE-QP-999-179-N004	DATE: 15/02/2020
	PROJECT:		PO NO.:	DATE:
	ITEM: PLATE HEAT EXCHANGER	SYSTEM: DMCW/ACW	SECTION:	SHEET 2 of 6

SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	D	**			
					M	C/ N					M	C	N	
1.3	Gaskets	Dimensions	MA	Measurement	100%	Sample	Approved Drawings	Approved Drawings	Inspection Reports	√	P,V	V	V	Co-related mill TCS to be provided.
		Workmanship And Finish	MA	Visual	100%	Sample	No damage, No Surface defects.	No damage, No Surface defects.	Inspection Reports	√	P,V	V	V	
		Contour	MA	Visual	100%	Sample	Mfg. Drgs / specification	Mfg. Drgs / specification	Inspection Reports	√	P,V	V	V	
		Hardness	CR	Measurement	100%	Sample	Approved Drawings	Approved Drawings	Inspection Reports	√	P,V	V	V	
1.4	Tightening Bolts & Nuts. (Tie Rod)	Physical Properties	MA	Physical Test	1/ Heat	1/ Heat	App. Drg / data sheet	Relevant Material Std.	Mill Tc Or Lab Test Report	√	P,V	V	V	
		Chemical Properties	MA	Chemical Analysis	1/ Heat	1/ Heat	App. Drg / data sheet	Relevant Material Std.	Mill Tc Or Lab Test Report	√	P,V	V	V	
		Dimensions	MA	Measurement	100%	100%	Approved Drawings	Approved Drawings	Inspection Reports	√	P,V	V	V	
		Workmanship and Finish	MA	Visual	100%	100%	Approved Drawings	Approved Drawings	Inspection Reports	√	P,V	V	V	
		Internal Soundness (For diameter >= 40 mm)	CR	UT	100%	100%	ASTM A 388	See Remark - 4	Inspection Reports	√	P,V	V	V	UT will be carried on raw material stage.
2.0	IN PROCESS INSPECTION													
2.1	HT PLATES	Area Measurement	NA	White Light Scanning	1 per Type	1 per Type	Approved drawing/ data sheet	Approved drawing/ data sheet	Inspection Reports	√	P,V	W	V	See Remark 2

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	19/2/20	NIKHIL DUBEY	Checked by:	19.02.20	MOHIT KUMAR
Reviewed by:	19/2/2020	VISHAL KR. YADAV	Reviewed by:	19/2/2020	RITESH KR. JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO : PE-TS-999-179-N001, R01	DATE: 02/05/18
	CUSTOMER :		QP NO.: PE-QP-999-179-N004	DATE: 15/02/2020
	PROJECT:		PO NO.:	DATE:
	ITEM: PLATE HEAT EXCHANGER	SYSTEM: DMCW/ACW	SECTION:	SHEET 3 of 6

SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	D	**			
					M	C/ N					M	C	N	
		Physical Properties	MA	Physical Test	1 Sample per Heat	1 Sample per Heat	Approved drawing/ data sheet	Relevant Material Std.	Mill TC or Lab Test Report	√	P,V	V	V	
		Chemical Properties	MA	Chemical Analysis	1 Sample per Heat	1 Sample per Heat	Approved/ drawing/ data sheet	Relevant Material Std.	Mill TC or Lab Test Report	√	P,V	V	V	
		Dimension	MA	Measurement	1 Sample per Heat	1 Sample per Heat	Approved drawing/ data sheet	Approved drawing/ data sheet	Inspection Report	√	P,V	V	V	
		Workmanship And Finish	MA	Visual	100%	100%	Approved drawing/ data sheet	No scratches, cracks etc.	Inspection Report	√	P,V	V	V	
		Surface Defects And Cracks	CR	DP test	10%	2 % or min. 100 nos. whichever is higher	Manufacturer's DP test procedure (to be reviewed and approved by BHEL/Customer during contract stage)		DPT Report	√	P,V	W	V	See Remark 3
				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	√	P,V	W	V	See Remark 3
		PMI testing	CR	PMI test	100 %	1 Sample per Heat	Approved drawing/ data sheet	Approved drawing/ data sheet	PMI Compliance report	√	P,V	V	V	See Remark 5

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	19/2/20	NIKHIL DUBEY	Checked by:	19.02.20	MOHIT KUMAR		
Reviewed by:	19/2/2020	VISHAL KR. YADAV	Reviewed by:	19/2/2020	RITESH KR. JAISWAL		

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO : PE-TS-999-179-N001, R01	DATE: 02/05/18
	CUSTOMER :		QP NO.: PE-QP-999-179-N004	DATE: 15/02/2020
	PROJECT:		PO NO.:	DATE:
	ITEM: PLATE HEAT EXCHANGER	SYSTEM: DMCW/ACW	SECTION:	SHEET 4 of 6

SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/ N				D	M	C	N	
2.2	Welding Procedures Specification (WPS)	Correctness	MA	Verification	100%	100%	ASME SEC-IX.	ASME SEC-IX.	QW 482 ASME SEC-IX	√	P,V	V	V	Customer /BHEL/ BHEL TPI / NPCIL, EIL, LLYODS) approved WPS shall be used for welding.
2.3	Procedure Qualification Records (PQR)	Suitability	MA	Visual & Mechanical Test	100%	100%	ASME SEC-IX.	ASME SEC-IX.	QW 483 ASME SEC-IX.	√	P,V	V	V	
2.4	Welders Performance Qualification	Welder's Performance Soundness Of Welds	MA	Visual / RT & Mechanical	100%	100%	ASME SEC-IX.	ASME SEC-IX.	QW 484 ASME SEC-IX	√	P,V	V	V	Customer /BHEL/ BHEL TPI / NPCIL, EIL, LLYODS) approved WPS shall be used for welding.
2.5	Weld joint of expander/reducer.	Welding Of Outer Flange To Reducer/Expander	MA	Visual	100%	100%	Approved Drawings	Approved Drawings	Inspection Report	√	P,V	V	V	
			CR	DPT	100%	100%	Manufacturer's DP test procedure (to be reviewed and approved by BHEL/Customer during contract stage)		DPT Report	√	P,V	W	V	
2.6	PHE Structure	Workmanship and finish	MA	Measurement & Visual	100%	100%	Approved Drawings	Approved Drawings	Inspection Report	√	P,V	V	V	
2.7	Plate Gaskets	Presence Of Gasket	MA	Visual	100%	100%	Mfg. Spec.	Mfg. Spec.	Inspection Report	√	P,V	W	V	
2.8	Plate arrangement to flow diagram	Correctness	CR	Visual as per flow diagram	100%	100%	Approved Drawing	Approved Drawings	Inspection Report	√	P,V	V	-	
2.9	Assembly of tightening bolts and nuts	Squeezing of threads on T/B	MA	Visual	100%	100%	Approved Drawing / Data sheet	Approved Drawing / Data sheet	Inspection Report	√	P,V	V	-	
2.10	Plate Pack	Length	MA	Dimension Measurement	100%	100%	Approved Drawing	Approved Drawing	Inspection Report	√	P,V	V	V	

BHEL						BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING			QUALITY			Sign & Date		Doc No:			
	Sign & Date	Name		Sign & Date	Name	Seal			Sign & Date	Name	Seal
Prepared by:	19/2/20	NIKHIL DUBEY	Checked by:	19.02.20	MOHIT KUMAR			Reviewed by:			
Reviewed by:	19/2/2020	VISHAL KR. YADAV	Reviewed by:	19/2/2020	RITESH KR. JAISWAL			Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO : PE-TS-999-179-N001, R01	DATE: 02/05/18
	CUSTOMER :		QP NO.: PE-QP-999-179-N004	DATE: 15/02/2020
	PROJECT:		PO NO.:	DATE:
	ITEM: PLATE HEAT EXCHANGER	SYSTEM: DMCW/ACW	SECTION:	SHEET 5 of 6

SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/ N				D	M	C	N	
3.0	FINAL INSPESTION													
3.1	Complete Assembly	a. Conformance to GA drg.	MA	Dimension Measurement	100%	100%	Approved Drawing	Approved Drawing	Inspection Report	√	P,V	W	W	
		B. Dimensions, No. of Heat Transfer Plates, Workmanship & finish	MA	Dimension Measurement	100%	100%	Approved Drawing	Approved Drawing	Inspection Report	√	P,V	W	W	
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	√	P,V	W	W	Hydro test @ 1.5 times the design pressure with 30 minutes holding time.
3.3	Unbalanced hydrostatic pressure (Secondary 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	√	P,V	W	W	Hydro test @ 1.5 times the design pressure with 30 minutes holding time.
3.4	Surface Preparation for Painting	Cleanliness (dust, dirt free, oil, grease free surface), surface profile	MA	Measurement & visual	100%	100%	Tech. Specs / App. Drawings	Tech. Specs / App. Drawings	Test Report	√	P,V	V	-	Surface profile as per SA 2.5
3.5	Painting	Dry film thickness & shade	MA	Measurement & visual	100%	100%	Customer/BHEL Tech. Spec. / Approved Data sheets		Test Report	√	P,V	V	V	
3.6	Packing	Completeness	MA	Measurement & visual	100%	100%	Customer/BHEL Tech. Spec. / Approved Data sheets		Test Report	√	P,V	V	V	Packing procedure as per Annexure B. **See Remarks 7**
REMARKS:-														

BHEL						BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING			QUALITY			Sign & Date		Doc No:			
	Sign & Date	Name		Sign & Date	Name	Seal			Sign & Date	Name	Seal
Prepared by:	19/2/20	NIKHIL DUBEY	Checked by:	19.02.20	MOHIT KUMAR			Reviewed by:			
Reviewed by:	19/2/2020	VISHAL KR. YADAV	Reviewed by:	19/2/2020	RITESH KR. JAISWAL			Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO : PE-TS-999-179-N001, R01	DATE: 02/05/18
	CUSTOMER :		QP NO.: PE-QP-999-179-N004	DATE: 15/02/2020
	PROJECT:		PO NO.:	DATE:
	ITEM: PLATE HEAT EXCHANGER	SYSTEM: DMCW/ACW	SECTION:	SHEET 6 of 6

SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/ N				D	M	C	N	

1	Co-related Mill TC's to be furnished by vendor to BHEL representative during inspection stage for review. BHEL to verify physical correlation of Mill TC's with material.
2	Inspection of Heat Transfer Plate Area Measurement shall be by White Light Scanning Method from BHEL (Refer Annexure –A). In case, inspection of plate area measurement by white light scanning method of specific PHE model has been witnessed by BHEL in past project then Type test certificates are acceptable to BHEL for same. The type test certificate shall not be more than 5 years old from date of inspection.
3.	Reg. Dye Penetrant Test & Light Box Test: There shall be random witness by BHEL/ Customer at Bidder's works, in case any defect is found in any of selected % of plates, the whole lot shell be tested in presence of BHEL & Customer. H.T. Plates without defect only shall be accepted.
4.	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.
5.	100% PMI Inspection for material grade of PHE Heat Transfer plates shall be from BHEL/ BHEL TPI. BHEL reserves the right to conduct random & independent PMI inspection on PHE's Heat Transfer plates to ascertain the plate material.
6.	BHEL reserves the right for conducting repeat test, if required.
7.	Photographs of packed material to be verified by BHEL before issuing MDCC.
8.	Project specific QP to be developed based on customer requirement.

LEGENDS:
*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,
** **M**: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, **C**: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, **N**: CUSTOMER, **D**: DOCUMENTATION
P: PERFORM, **W**: WITNESS, **V**: VERIFICATION, AS APPROPRIATE
MA: MAJOR, **MI**: MINOR, **CR**: CRITICAL

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	19/2/20	NIKHIL DUBEY	Checked by:	19.02.20	MOHIT KUMAR		
Reviewed by:	19/2/2020	VISHAL KR. YADAV	Reviewed by:	19/2/2020	RITESH KR. JAISWAL		

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

Annexure-A to Standard Quality Plan

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 shown in the **Annexure 1**.

Steps to Measure the Heat transfer 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 area 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

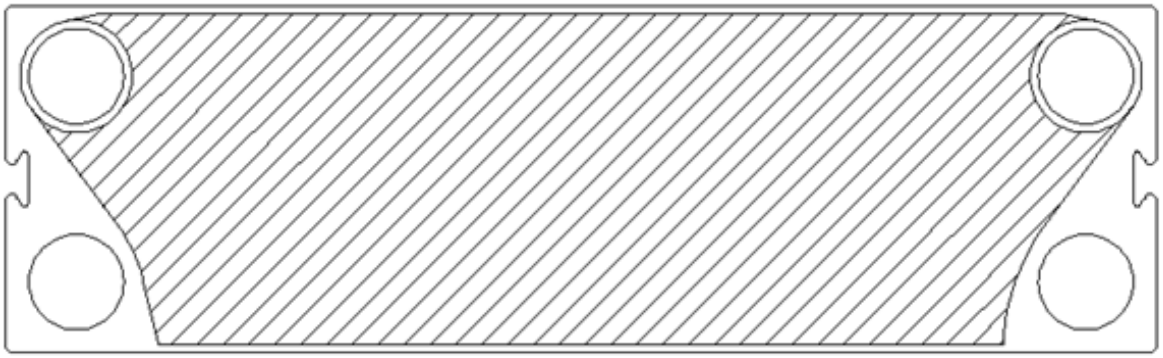

Fig. 1: Wetted Surface Area for Parallel Connection

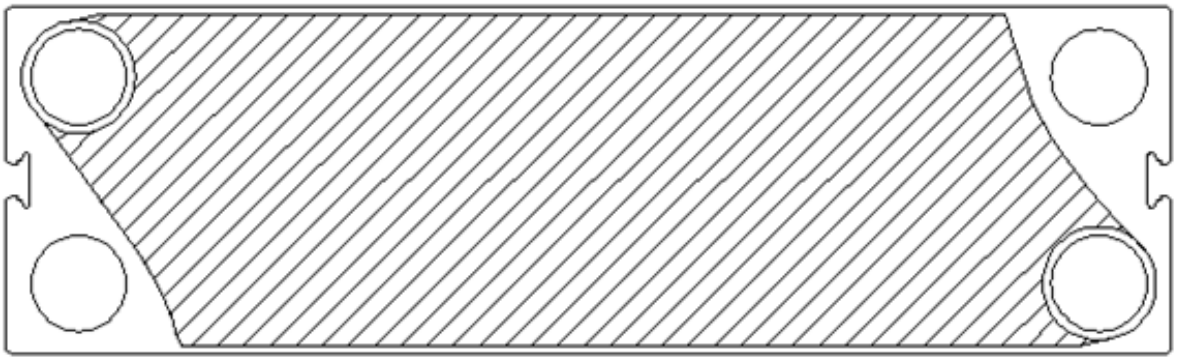

Fig. 2: Wetted Surface Area for Diagonal Connection

Annexure-B to Standard Quality Plan

PHE packing procedure before dispatch

1. Purpose:

The purpose of this procedure is to outline the requirements and procedures for protecting the equipment's during shipment and preserving during the storage.

2. Preparation for Packing:

- After hydro testing, operation, all fluids e.g. water etc., shall be completely drained from all PHE's, and the equipment blown dry.
- All material shall be cleaned internally and externally to remove, scale, rust fillings and any other foreign material.
- The PHE shall be placed on a strong wooden base & bolted to the wooden base using the foundation holes for further transportation upto site.

3. Protection of parts:

- Plate Heat Exchangers shall be packed in proper sizes of wooden cases. High grade woods like Rubber woods, jungle wood, hard wood, mango wood, pine wood, etc. is used for packing.
- All finished (or) machined (External C.S. Surfaces shall be protected against corrosion with corrosion resisting coating, which is easily removable (Compound shall be such that it will remain on the surface at temperature normally encountered during shipping & storage).
- All machined surfaces shall be protected from mechanical damage. All external unfinished carbon steel surfaces shall be sand blasted & shall be coated with rust preventive primer.
- Flanged opening if any shall be covered with blank flanges sealed with blank gasket of natural rubber or equivalent. Butt welded opening shall be closed with temporary closing covers. Internal threads shall be protected with metal plug sealed with Teflon tape (if applicable). External thread shall be protected with PVC sleeve.
- Wooden cases shall be covered with HDPE cloth from inside wooden box and the top. All the opening in plate heat exchanger shall be closed properly by suitably covering to prevent foreign material entering in plate heat exchanger.
- Loose material, primary and secondary a shall be packed in corrugated box and plastic bags with proper tagging.
- All fabricated wooden cases & crates conform to the requirement as per table given below:

Gross Weight [Kgs.]	Board Thickness	Batton / Rafter Thickness
2000 to 9000	Min. 30 mm	Min. 35 mm

9000 to 18000	Min. 50 mm	Min. 35 mm

- All the equipment shall be protected for entire period of dispatch, storage and erection against corrosion, incidental damage due to vermin, sunlight, rain, high temperature, humid atmosphere, rough handling in transit and storage. All MS parts which are not painted shall be provided with coating of grease.
- Clay Desiccant or such other moisture absorbing material in small cotton bags shall be placed and tied at various points on the equipment, wherever necessary.

4. Special tools and Spare parts:

Special tools and tackles and spares shall be packed separately with adequate identification. Such packages shall be identified as Tools/Commissioning/Operational spares.

5. Preservation

The equipment's shall be stored under closed/open space in packed condition until installation. The packages containing loose plates and gaskets are to be protected from extreme climatic conditions.

SECTION III

IIIA COMPLIANCE CERTIFICATE (TO BE SUBMITTED BY BIDDER DURING TENDER STAGE).

IIIB GUARANTEE SCHDULE (TO BE SUBMITTED BY BIDDER DURING TENDER STAGE).

IIIC DATASHEET –B FORMAT (TO BE SUBMITTED BY SUCESSFUL BIDDER AFTER AWARD OF CONTRACT).

COMPLIANCE CERTIFICATE

The bidder shall confirm compliance with following by signing/ stamping this compliance certificate and furnishing same with the offer

a.) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions/ deviations with regard to same.

b.) QP/ test procedures shall be submitted in the event of order based on the guidelines given in the specification & QP enclosed therein.
QP will be subject to BHEL/Customer approval in the event of order & customer hold points for inspection/ testing shall be marked in the QP at the contract stage. Inspection/ testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc.
The charges for 3rd party inspection (Lloyds, TUV or equivalent) for imported components shall be included in the base price of the equipment by the bidder.

c.) All drawings/data – sheets etc. to be submitted during contract shall be subject to BHEL/Customer review/ approval.
GA drawings, as submitted with offer at tender stage are for reference purpose only and shall be subject to approval during contract stage.

d.) There are no other deviations with respect to specification other than those furnished in the 'Schedule of Deviations'

e.) The offered materials shall be either equivalent or superior to those specified. Also for components where material is not specified it shall be suitable for intended duty, materials shall be subject to approval in the event of order.

f.) The commissioning spares (if any) are supplied on 'As Required Basis' & prices for same included in the base price (If bidders reply to this is "No commissioning spares are required" and if some spares are actually required during commissioning same shall be supplied by bidder without any cost to BHEL).

g.) All sub vendors shall be subject to BHEL/CUSTOMER approval.

h.) Any special tools & tackles, if required, shall be in bidder's scope.

i.) Performance Guarantees for PHE's shall stand valid as per commercial terms and conditions.

j.) Regarding bidder's association with their respective Principals (Plate & Gasket supplier) bidder confirms the following:

i. Plate supplier shall vet the thermal design of PHE at tender and contract stage and certify the adequacy of design and number of plates.
ii. Guarantee schedule duly vetted by Principal shall be submitted during contract stage.
iii. Bidders have back to back arrangement with their principal for technical guarantees.

	SCHEDULE OF PERFORMANCE GUARANTEES		SPECIFICATION NO.	PE-TS-426-179-N001
			Section	IIIB
	PLATE HEAT EXCHANGER		Rev No.	01
SL. NO.	**DESCRIPTION**	**UNIT**	**GUARANTEE VALUE**	
			DMCW-TG PHE	**DMCW-SG PHE**
1.0	**PRIMARY SIDE (HOT WATER SIDE)**			
	CLEAN CONDITION			
a)	Flow rate	M^3/Hr.		
b)	DMCW inlet temperature	^oC		
c)	DMCW outlet temperature	^oC		
d)	Pressure drop	MWC		
2.0	**SECONDARY SIDE (COLD WATER SIDE)**			
	CLEAN CONDITION			
a)	Flow rate	M^3/Hr.		
b)	ACW inlet temperature	^oC		
c)	ACW outlet temperature	^oC		
d)	Pressure drop	MWC		
3.0	**PRIMARY SIDE (HOT WATER SIDE)**			
	FOULED CONDITION			
a)	Flow rate	M^3/Hr.		
b)	DMCW inlet temperature	^oC		
c)	DMCW outlet temperature	^oC		
d)	Pressure drop	MWC		
4.0	**SECONDARY SIDE (COLD WATER SIDE)**			
	FOULED CONDITION			
a)	Flow rate	M^3/Hr.		
b)	ACW inlet temperature	^oC		
c)	ACW outlet temperature	^oC		
d)	Pressure drop	MWC		

PARTICULARS OF BIDDER/ AUTHORISED REPRESENTATIVE

NAME

SIGNATURE

DATE

	Title **DATA SHEET - B**	**SPECIFICATION NO.** PE-TS-426-179-N001
BHEL	**PLATE HEAT EXCHANGER**	VOLUME **III** SECTION **B**
		SHEET 1 OF 7

INSTRUCTION TO BIDDER

1. This data sheet shall be read in conjunction with Specification No. PE-TS-426-179-N001, Rev-01, Section – IA & IB.
2. Items which deviate from Specification shall be marked with an asterisk (*)

SL.NO.	ITEM	UNIT	PARTICULARS	
1.0	**General**			
1.1	Number of plate heat exchangers being supplied.	Nos.		
1.2	Manufacturer			
1.3	Model Number/ Type			
1.4	Whether single or double pass			
1.5	Flow Pattern			
2.0	**Design**			
2.1	Design Pressure	bar (g)		
2.2	Design Temperature	^oC		
2.3	Heat Load(without LMTD correction)	KW		
2.4	Heat Load(with LMTD correction)	KW		
2.5	LMTD (Corrected)	^oC		
3.0	**Guaranteed Performance for Each Heat Exchanger (in fouled condition)**		**Primary Side (Hot Fluid)**	**Secondary Side (Cold Fluid)**
3.1	Flow rate	M^3/hr		
3.2	Inlet temperature	^oC		
3.3	Outlet temperature	^oC		
3.4	Total pressure drop across heat exchanger from inlet to outlet(including inlet & outlet nozzles) a) For design flow b) For 110% design flow rate	bar		
4.0	**Heat Transfer & Fluid flow data**		**Primary Side (Hot Fluid)**	**Secondary Side (Cold Fluid)**
4.1	Film heat transfer co-efficient	$KCal/hrM^2\,^oC$		
4.2	Fouling factor	$M^2hr\,^oC/KCal$		

Name of Bidder/ Vendor					
Revision Number	**0**	**1**	**2**	**3**	**4**
Signature of Bidder/ Vendor Authorised Representative					
Date :					

INSTRUCTION TO BIDDER

1. This data sheet shall be read in conjunction with Specification No. PE-TS-426-179-N001, Rev-01, Section – IA & IB.
2. Items which deviate from Specification shall be marked with an asterisk (*)

SL.NO.	ITEM	UNIT	PARTICULARS
4.3	Overall fouling	M^2 hr^{o}C/KCal	
4.4	Overall heat transfer coefficient	KCal/hrM^2 ^{o}C	
	a) In clean conditions		
	b) In fouled conditions		
4.5	Total effective heat transfer area per heat exchanger	M^2	
4.6	Average velocity	m/s	
	a) Through ports		
	b) Through Plate Channels		
4.7	Pressure drop in ports	bar	
4.8	Pressure drop in channels	bar	
4.9	Maximum differential pressure between hot and cold fluids in plate channels (operating)	bar (g)	
5.0	**Heat Transfer Plates**		
5.1	Area of each plate	M^2	
5.2	Dimension (width x height)	mm x mm	
5.3	Thickness	mm	
5.4	Material & chemical composition		
5.5	Number of plates per heat exchanger	Nos.	
5.6	Maximum number of plates that can be accommodated in the heat exchanger frame	Nos.	
5.7	Type of corrugation		
5.8	Minimum plate pack length	mm	

Name of Bidder/ Vendor					
Revision Number	**0**	**1**	**2**	**3**	**4**
Signature of Bidder/ Vendor Authorised Representative					
Date :					

INSTRUCTION TO BIDDER

1. This data sheet shall be read in conjunction with Specification No. PE-TS-426-179-N001, Rev-01, Section – IA & IB.
2. Items which deviate from Specification shall be marked with an asterisk (*)

SL.NO.	ITEM	UNIT	PARTICULARS
	a) As per 5.5 above b) As per 5.6 above		
		mm	
	Maximum plate pack length a) As per 5.5 above b) As per 5.6 above		
5.9	Average spacing between two plates	mm	
5.10	Hold up volume of each passage	M^3	
5.11	Port size (diameter)	mm	
6.0	**Plate Gaskets**		
6.1	Type		
6.2	Material and composition		
6.3	Thickness of gasket	mm	
6.4	Hardness of gasket		
6.5	Expected life of gasket		
7.0	**Carrying Bar**		
7.1	Type of construction		
7.2	Number per heat exchanger		
7.3	Size		
7.4	Material		
8.0	**Guide Bar**		
8.1	Type of construction		
8.2	Number per heat exchanger		
8.3	Size		
8.4	Material		
9.0	**Frame Plate**		

INSTRUCTION TO BIDDER

1. This data sheet shall be read in conjunction with Specification No. PE-TS-426-179-N001, Rev-01, Section – IA & IB.
2. Items which deviate from Specification shall be marked with an asterisk (*)

SL.NO.	ITEM	UNIT	PARTICULARS	
9.1	Type of Construction			
9.2	Material			
10.0	**Pressure Plate**			
10.1	Type of construction			
10.2	Material			
11.0	**Supporting Columns**			
11.1	Type of Construction			
11.2	Material			
12.0	**Clamping/Gasket Compression Arrangement**			
12.1	Type of arrangement			
12.2	Tie Rod size & material (Length to take care 25% extra plates)			
12.3	Tie Rod Nuts size & material			
12.4	Nozzle flange stud size & material			
12.5	Nozzle flange Nut size & material			
13.0	**Inlet & outlet Connection Nozzles**		**Primary Side (Hot Fluid)**	**Secondary Side (Cold Fluid)**
13.1	Size	mm		
13.2	Rating			
13.3	Facing & drilling standard			
13.4	Flange material			
13.5	Are all nozzles counter-flanges, bolts, nuts, gaskets etc., are included in the		YES/NO	

Name of Bidder/ Vendor					
Revision Number	**0**	**1**	**2**	**3**	**4**
Signature of Bidder/ Vendor Authorised Representative					
Date :					

INSTRUCTION TO BIDDER

1. This data sheet shall be read in conjunction with Specification No. PE-TS-426-179-N001, Rev-01, Section – IA & IB.
2. Items which deviate from Specification shall be marked with an asterisk (*)

SL.NO.	ITEM	UNIT	PARTICULARS
	offer?		
14.0	Recommended Cleaning frequency of the heat exchanger for assumed fouling factor	Months	
15.0	Is backwash necessary		YES/NO
16.0	Are all auxiliaries and accessories included in the offer		YES/NO
17.0	Are all counter-flanges with nuts, bolts and gaskets for all terminal points included in the offer?		YES/ NO
18.0	Are all heat exchangers supplied with necessary foundation plates, anchor, bolts, sleeves, inserts, lifting lugs etc., as specified.		YES/ NO
19.0	**Shop Tests & Inspection**		
19.1	Whether all the tests and inspections as detailed in the specification/ quality plan are carried out		YES/ NO
19.2	Hydrostatic Test :		
	a) Test Pressure	bar (g)	
	b) Test duration	min.	
19.3	Are all plates checked for cracks and other defects by the penetration method?		YES/NO

INSTRUCTION TO BIDDER

1. This data sheet shall be read in conjunction with Specification No. PE-TS-426-179-N001, Rev-01, Section – IA & IB.
2. Items which deviate from Specification shall be marked with an asterisk (*)

SL.NO.	ITEM	UNIT	PARTICULARS
	If not, what percentage is checked?		
19.4	Is hardness test conducted for plate gaskets?		YES/NO
20.0	**Details of Painting**		
20.1	***Exterior surface*** a) Surface preparation b) Primer c) Finish Preparation		
20.2	***Interior Surface*** a) Surface preparation b) Primer c) Finish Preparation		
21.0	Weight of each heat exchanger a) Empty b) Flooded Flooded Weight of heat exchanger with Max. Plates	kg.	
22.0	Overall dimensions - (Length x Breadth x Height)	mm x mm x mm	
23.0	withdrawal space		
24.0	Recommended Maintenance tools and tackles furnished		Yes/No

Name of Bidder/ Vendor					
Revision Number	**0**	**1**	**2**	**3**	**4**
Signature of Bidder/ Vendor Authorised Representative					
Date :					

	Title **DATA SHEET - B**	**SPECIFICATION NO.** PE-TS-426-179-N001
BHEL	**PLATE HEAT EXCHANGER**	VOLUME **III** SECTION **B**
		SHEET 7 OF 7

INSTRUCTION TO BIDDER

1. This data sheet shall be read in conjunction with Specification No. PE-TS-426-179-N001, Rev-01, Section – IA & IB.
2. Items which deviate from Specification shall be marked with an asterisk (*)

SL.NO.	ITEM	UNIT	PARTICULARS
25.0	Mesh Size of recommended Strainer	mm	
26.0	Foundation nuts and bolts supplied		Yes/No
27.0	Other information (if any)		

Name of Bidder/ Vendor					
Revision Number	**0**	**1**	**2**	**3**	**4**
Signature of Bidder/ Vendor Authorised Representative					
Date :					