2x800 MW NTPC LARA STPP

2x800 MW NTPC SINGRAULI STPP

TECHNICAL SPECIFICATION
FOR
PLATE HEAT EXCHANGER (PHE)

SPECIFICATION No.
PE-TS-508/512-179-W001
REV NO. 00

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA, INDIA

INDEX

PROJECT INFORMATION

2X800 MW LARA STPP

SL.NO	DESCRIPTION	DETAILS
1	**METEOROLOGICAL DATA**	
1.1	MAXIMUM TEMPERATURE	48.3 Deg C
1.2	MINIMUM TEMPERATURE	6.4 Deg C
1.3	MAXIMUM RELATIVE HUMIDITY	0.84
1.4	MINIMUM RELATIVE HUMIDITY	0.22
1.5	AVERAGE ANNUAL RAINFALL	1429.3 mm
1.6	SEISMIC ZONE (AS PER IS 1893)	Zone: IV as defined in IS:1893-2002
1.7	HEIGHT ABOVE MSL	(+) 207 Meter above Mean Sea Level
1.8	BASIC WIND SPEED (AS PER IS 875)	44 m/s
1.9	SOIL BEARING CAPACITY (TONNE/ SQ.MTR)	NA
2	**ELECTRICAL DATA**	
2.1	AMBIENT TEMPERATURE FOR DESIGN OF ELECTRICAL	50 deg C
2.2	RATED FREQUENCY	50 Hz
2.3	FREQUENCY VARIATION	(+)3% to (-)5%
2.4	AC VOLTAGE	415V, 3 Phase
2.5	AC VOLTAGE VARIATION	+/-10%
2.6	DC VOLTAGE	220V
2.7	DC VOLTAGE VARIATION	(+)10% to (-)15%
2.8	FAULT LEVEL (KA/SEC)	50 at rated voltage

2X800 MW SINGRAULI PROJECTS

SL.NO	DESCRIPTION	DETAILS
1	**METEOROLOGICAL DATA**	
1.1	MAXIMUM TEMPERATURE	48.8 Deg C
1.2	MINIMUM TEMPERATURE	1 Deg C
1.3	MAXIMUM RELATIVE HUMIDITY	85%
1.4	MINIMUM RELATIVE HUMIDITY	20%
1.5	AVERAGE ANNUAL RAINFALL	1132.7 mm
1.6	SEISMIC ZONE (AS PER IS 1893)	Zone: IV as defined in IS:1893-2002
1.7	HEIGHT ABOVE MSL	(+) 272.0 Meter above Mean Sea Level
1.8	BASIC WIND SPEED (AS PER IS 875)	47 m/s
1.9	SOIL BEARING CAPACITY (TONNE/ SQ.MTR)	NA
2	**ELECTRICAL DATA**	
2.1	AMBIENT TEMPERATURE FOR DESIGN OF ELECTRICAL	50 deg C
2.2	RATED FREQUENCY	50 Hz
2.3	FREQUENCY VARIATION	(+)3% to (-)5%
2.4	AC VOLTAGE	415V, 3 Phase
2.5	AC VOLTAGE VARIATION	+/-10%
2.6	DC VOLTAGE	220V
2.7	DC VOLTAGE VARIATION	(+)10% to (-)15%
2.8	FAULT LEVEL (KA/SEC)	50 at rated voltage

GENERAL TECHNICAL REQUIREMENT

1	The design, manufacture and testing of the plate heat exchanger complete with all accessories, shall generally conform to the latest editions of the appropriate standards.
2	The equipment shall comply with all applicable safety codes and statutory regulations of India where the equipment is to be installed.
3	Unless otherwise necessary manufacturer's standard and proven models of the plate heat exchanger shall be supplied.
4	Latest codes and standards shall be applicable as on date of bid submission.
5	In the event of any conflict between the requirements of two clauses of this specification, documents or requirements of different codes and standards specified, stringent requirement as per the interpretation of the owner shall apply.
6	Bidder to note that drawing/document submission shall be through web based Document Management System. Bidder will be provided access to the DMS along with adequate training for drg/doc approval. Bidder to ensure proper net connectivity at their end.
7	The first submission/ revised submission of drawings/ documents by vendor shall be complete in all respects. Incomplete drawing submitted shall be treated as non- submission with delays attributable to vendor's account. For any clarification/ discussion required to complete the drawings, the bidder shall depute his personal to BHEL / Customer's place as per the requirement for across the table submissions/ discussions/ finalizations of drawings.
8	Drawing / documents to be submitted by bidder shall be as per "Documentation Requirement" given in this specification.
9	The details of the Plate Heat Exchangers with the quantity, design parameters, accessories etc. to be supplied shall be as per "TECHNICAL DATA, PART - A" enclosed in this specification.
10	Metallurgy specified in Technical Data Part-A is minimum. Equivalent or Superior materials suitable for fluid handled are also acceptable subject to Customer/BHEL approval.
11	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.
12	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.
13	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.
14	For the purpose of calculating dirty overall heat transfer coefficient a total fouling factor as given in TECHNICAL DATA, PART - A shall be assumed. It is expected that the cleaning frequency shall be once in a year with the above fouling factor.
15	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.
16	All nozzles shall be flanged type and shall be as specified in TECHNICAL DATA, PART - A.
17	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.
18	Each plate shall be numbered in sequence. The number shall be marked by indelible ink on the plate to permit easy reassembly.
19	Equipment must be safe, reliable, and easy to maintain at all operating conditions.

20	It is mandatory for the bidder to submit along with the bid, the deviations if any – whether major or minor in the schedule of deviations only. In the absence of deviations listed in the "Schedule of deviations, the offer shall be deemed to be full conformity with the specification, "not-withstanding" anything else stated elsewhere in bidder's offer. The implied/indirect deviations shall not be binding on the purchaser.
21	All sub vendors shall be subject to BHEL/CUSTOMER approval.

	TECHNICAL DATA, PART - A	
1.0	**Scope of Supply & Services**	
	The scope covers the design, manufacture, assembly, inspection and testing at manufacturer's and/or his sub-contractors works, proper packing for delivery of Plate Heat Exchangers along with mandatory spares complete with all accessories as per the requirements specified in this specification, PG Test at site and any other services, etc. if called for in the succeeding sections of the specification.	
1.1	Scope of supply of PHE Accessories and Spares in Bidder's Scope:	
1.1.1	Supporting arrangement complete with foundation plate channels, anchor bolts, nuts, sleeves, inserts etc.	
1.1.2	Matching piece (Reducer/Expander) if required to match to connecting pipe	
1.1.3	Matching counterflanges with gasket and fasteners for flanged connections	
1.1.4	Inspection ports with blind flange at the End plates of the PHE.	
1.1.5	Drain & vent connections for both side complete with isolation valves	
1.1.6	Lifting arrangement i.e., lifting lugs, eye bolts etc.	
1.1.7	Painting protection for all external and internal carbon steel surfaces	
1.1.8	One Ratchet spanner for each type of PHE	
1.1.9	Mandatory spares as per BOQ provided in specification	
1.1.1	E&C spares, special tools & tackles (as applicable)	
1.2	Scope of Services:	
1.2.1	PG Test at site	
2.0	**DESIGN CODES & STANDARDS**	
2.1	Design Standard	IS/BS/DIN/ASTM/ASME Standards
2.2	Thickness of pressure and frame plates, corrosion allowance etc.	As per ASME Sec-VIII, Div.1
2.3	Pipe Flanges and Flanged Fittings	ASME B 16.5
2.4	Structural steel	IS 2062
2.5	Threaded Steel Fasteners	IS 1367
2.6	Alloy-Steel and Stainless Steel Bolting	ASTM A193
2.7	Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts	ASTM A194
2.8	Stainless Steel Plate, Sheet, and Strip for Pressure Vessels	ASTM A240
2.9	Piping Fittings of Wrought Carbon Steel and Alloy Steel	ASTM A234
2.10	Carbon Steel Castings	ASTM A216

TECHNICAL DATA, PART - A

2.11	Carbon Steel Forgings		ASTM A105			
2.12	Steel Bars, Carbon and Alloy, Hot-Wrought		ASTM A29			
2.13	Stainless Chromium-Nickel Steel-Clad Plate		ASTM A264			
2.14	Carbon Steel Plates		ASTM A283			
	DESCRIPTION	**UOM**	**DETAIL**			
	PHE Designation		**PHEs for Lara Project**		**PHEs for Singrauli Project**	
3.0	**DESIGN /SYSTEM PARAMETERS**		**TG PHE**	**SG PHE**	**TG PHE**	**SG PHE**
3.1	PHE Configuration		2W+1S	2W+1S	2W+1S	2W+1S
3.2	PHE Quantity for each Unit	Nos.	3	3	3	3
3.3	PHE Quantity for each project (2 Units)	Nos.	6	6	6	6
3.4	Primary side (Hot) Fluid		Passivated DM Water (pH around 9.5)			
3.5	Secondary side (Cold) Fluid		Clarified Water			
3.6	Design Pressure	kg/cm^2 (g)	10			
3.7	Design Temperature	Deg. C	60			
3.8	Operating Pressure (Primary side)	kg/cm^2 (g)	5.0-5.6	7.0-8.0	5.0-5.6	7.0-8.0
3.9	Operating Pressure (Secondary side)	kg/cm^2 (g)	2.5-3.5	2.5-3.5	2.5-3.5	2.5-3.5
3.10	Minimum HT plate thickness	mm	0.6	0.6	0.6	0.6
3.10.	Negative tolerance allowed on HT plate thickness	%	Zero			
3.11	Heat Transfer per Sq.Mtr. Of Heat Transfer Plate	Kcal/Hr./m^2	6500			
3.12	Specific Heat of Fluid - Primary side	Cal/gmDeg.C	1.0			
3.13	Specific Heat of Fluid - Secondary side	Cal/gmDeg.C	1.0			
3.14	Density of Fluid - Primary side	gm/cc	1.0			
3.15	Density of Fluid - Secondary side	gm/cc	1.0			
3.16	Overall fouling resistance (minimum) [Considering cleaning frequency once in a year]	Hr m2deg C/Kcal	0.00008			
3.17	Minimum corrosion allowance on heat exchanger parts of carbon steel (e.g. pressure parts, nozzles, sliding channel and frame)	mm	1.6			

	TECHNICAL SPECIFICATION PLATE HEAT EXCHANGER 2X800 MW NTPC LARA & SINGRAULI PROJECTS	PE-TS-508/512-179-W001 Rev. No. 00 Date : 20.02.2025

TECHNICAL DATA, PART - A

4.0	**PERFORMANCE PARAMETERS**		**TG PHE**	**SG PHE**	**TG PHE**	**SG PHE**
4.1	Design Flow Rate - Primary side	M^3/hr	1083	922	1083	921
4.2	Design Flow Rate - Secondary side	M^3/hr	1300	1150	1300	1155
4.3	Inlet temperature - Primary side	Deg. C	45.6	45.9	45.6	45.9
4.4	Inlet temperature - Secondary side	Deg. C	36.0	36.0	36.0	36.0
4.5	Outlet temperature (in fouled condition) - Primary side	Deg. C	38.0	38.0	38.0	38.0
4.6	Outlet temperature (in fouled condition) - Secondary side	Deg. C	42.34	42.34	42.34	42.34
4.7	Maximum allowable pressure loss at design flow in fouled conditions - Primary side	MWC	6.0	6.0	6.0	6.0
4.8	Maximum allowable pressure loss at design flow in fouled conditions - Secondary side	MWC	7.0	7.0	7.0	7.0
5.0	**CONSTRUCTION FEATURES**		**TG PHE**	**SG PHE**	**TG PHE**	**SG PHE**
5.1	Location of PHE		Indoor	outdoor	Indoor	outdoor
5.2	Connecting Pipe Material		Carbon steel IS 2062, E250 Gr. B			
5.3	Connecting Pipe Size - Primary side (OD x THK)	NB mm	450 (457.0 x 6.0)	400 (406.4 x 6.0)	450 (457.0 x 6.0)	400 (406.4 x 6.0)
5.4	Connecting Pipe Size - Secondary side (OD x THK)	NB mm	450 (457.0 x 6.0)	450 (457.0 x 6.0)	450 (457.0 x 6.0)	450 (457.0 x 6.0)
5.5	Maximum permitted Length of the PHE (excluding reducer)	mm	4500	4500	4500	4500
5.6	Additional HT plates on Design Plates	%	NIL	NIL	NIL	NIL
5.7	Extra Carrying capacity to be provided on frame assembly	%	25	25	25	25
5.8	Single Pass / Double Pass		Single Pass			
5.9	Flow Pattern		Counter Flow			
5.10	PHE backwash		No			
6.0	**Material of Construction**					
6.1	Heat Transfer Plates		SS316			
6.2	Plate Gasket		Nitrile rubber			
6.3	Compression/Fixed/Frame/Movable Pressure plates		Carbon Steel, IS-2062 E250, Gr. B			
6.4	Carrying Rails / bar		Carbon Steel, IS-2062, E250 Gr.B, with SS Cladding			
6.5	Guide Rails/ bar		Carbon Steel, IS-2062, E250 Gr.B, with SS Cladding			

TECHNICAL DATA, PART - A

6.6	Support Beam/ column		Carbon Steel, IS-2062 E250, Gr. B
6.7	Nozzle (Reducer/Expander) - Primary Side		Carbon Steel, IS-2062 E250, Gr. B
6.8	Nozzle (Reducer/Expander) - Secondary Side		Carbon Steel, IS-2062 E250, Gr. B
6.9	Nozzle flanges		Carbon Steel, IS-2062, E-250, Gr.B (Confirming to ANSI B 16.5 class, Min.-150 lb)
6.10	Nozzle flange bolts / nuts		SA 193 B7/ SA 194 2H
6.11	Nozzle flange gasket		3mm wire inserted Red Rubber
6.12	Flange/ Counter flanges		Carbon Steel, IS-2062, E-250, Gr.B (Confirming to ANSI B 16.5 class, Min.-150 lb)
6.13	Tightening Bolts/Rods & Nuts		IS-1367 Gr.8.8 or equivalent
6.14	Name Plate		SS 316 (min. 3 mm thick)
6.15	Wetted fasteners		SS-316
7.0	**INSPECTION/TESTING**		
7.1	Hydrotesting Pressure	kg/cm^2 (g)	1.5 times the design pressure
7.2	Duration of Hydrotesting	minutes	30

TECHNICAL DATA - PART - B (SUPPLIER DATA TO BE FURNISHED AFTER AWARD OF CONTRACT)

SL.NO	DESCRIPTION	UOM	DETAIL
1.0	Manufacturer		
2.0	Model Number/ Type		
3.0	Heat Load		
a	Primary Side	Kcal/hr KW	
b	Secondary Side	Kcal/hr KW	
4.0	LMTD	DegC	
5.0	Total pressure drop across heat exchanger from inlet to outlet (including inlet & outlet nozzles) - at design flow		
a)	Primary Side	MWC	
b)	Secondary Side	MWC	
6.0	Total pressure drop across heat exchanger from inlet to outlet (including inlet & outlet nozzles) - at 110% of design flow	MWC	
a)	Primary Side	MWC	
b)	Secondary Side	MWC	
7.0	Film heat transfer co-efficient		
a)	Primary Side	KCal/hrM^2 ^{o}C	
b)	Secondary Side	KCal/hrM^2 ^{o}C	
8.0	Overall heat transfer coefficient - in clean condition	KCal/hrM^2 ^{o}C	
9.0	Overall heat transfer coefficient - in fouled condition	KCal/hrM^2 ^{o}C	
10.0	Total effective heat transfer area per heat exchanger	M^2	
11.0	Average Velocity through ports		
a)	Primary Side	m/s	
b)	Secondary Side	m/s	
12.0	Average Velocity through Plate Channels		
a)	Primary Side	m/s	
b)	Secondary Side	m/s	
13.0	Pressure drop in ports		
a)	Primary Side	MWC	
b)	Secondary Side	MWC	
14.0	Pressure drop in channels		
a)	Primary Side	MWC	
b)	Secondary Side	MWC	
15.0	Maximum operating differential pressure between hot and cold fluids in plate channels	kg/cm^2 (g)	
16.0	Area of each HT plate	M^2	
17.0	Dimension (width x height) of HT Plate	mm x mm	
18.0	Number of plates per heat exchanger	Nos.	
19.0	Maximum number of plates that can be accommodated in the heat exchanger frame	Nos.	
20.0	Type of corrugation in HT Plate		

TECHNICAL DATA - PART - B (SUPPLIER DATA TO BE FURNISHED AFTER AWARD OF CONTRACT)

SL.NO	DESCRIPTION	UOM	DETAIL
21.0	Minimum plate pack length: i) As per 18.0 above ii) As per 19.0 above	mm	
22.0	Maximum plate pack length: i) As per 18.0 above ii) As per 19.0 above	mm	
23.0	Average spacing between two plates	mm	
24.0	Hold up volume of each passage	m^3	
25.0	Port size (diameter)		
a)	Primary Side	mm	
b)	Secondary Side	mm	
26.0	Plate Gasket Type		
27.0	Thickness of gasket	mm	
28.0	Hardness of gasket		
29.0	Nozzle flange class and drilling standard		
30.0	Overall Length of PHE		
a)	Excluding Reducer/Expander	mm	
b)	Inculding Reducer/Expander	mm	
31.0	Withdrawal Space / Maintenance Space required around each PHE	mm	
32.0	Hydrotest Pressure	kg/cm2 (g)	

PERFORMANCE GUARANTEES TO BE DEMOSTRATED AT SITE

PG Testing at Site

1 The guaranteed performance parameters of the plate heat exchangers shall be proved by the supplier during the performance testing at site (as applicable).

2 Following to be demonstrated at site:

a Heat transfer coefficient determining the performance under design heat load and inlet & outlet temperatures of the plate type heat exchangers on the primary and secondary side.

b Pressure drop across the plate type heat exchanger on the primary and secondary water circuit.

3 Vendor to replace / take corrective action for any deficiency in performance parameters at site. If the site performance is found not meeting the requirements in any respect as specified, then the equipment shall be rectified or replaced by the vendor, without any price implication.

4 All duly calibrated instruments required for PG testing including for flow measurements (Ultra-sonic flow meter / similar type of instrument) shall be arranged by the bidder and taken back after the Test.

5 The computation of flow by characteristics curve of Pumps for PG Testing of PHE’s is not permitted.

6 At the time of performance testing, cleaning of the plates (if required) shall be arranged by the supplier.

	TECHNICAL SPECIFICATION PLATE HEAT EXCHANGER 2X800 MW NTPC LARA & SINGRAULI PROJECTS	PE-TS-508/512-179-W001 Rev. No. 00 Date : 20.02.2025		
SL. NO.	**DESCRIPTION**	**UOM**	**GUARANTEE VALUE**	
	(To be Filled separately for each project)		**TG PHE**	**SG PHE**
1.0	**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		
2.0	**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

PG TEST PROCEDURE FOR TG & SG PLATE HEAT EXCHANGER (PHE)

Station : ----------

Drawing no : ----------

CONTENTS FOR PHE PROCEDURE

1.0 Objective & Scope

The function of Plate Heat Exchanger is to maintain the desired temperature of equipment cooling water system in closed cycle. The purpose of this procedure is to provide the methodology for determining the performance of PHE's as per **Guarantees condition as defined in 2.0 below** & with regard to the proper functioning of the PHE by comparing the actual heat transfer coefficient with the expected overall heat transfer coefficient.

2.0 GUARANTEES:

Technical datasheet specification : Approved technical datasheet drawing no ----------.

Mention technical datasheet parameters (temperature & flow) in fouled condition for guarantee condition with pr drop value.

DM water leaving PHE's is a function of heat transfer coefficient of the PHE's, the actual overall heat transfer coefficient shall be calculated and compared with expected overall heat transfer coefficient. In case of the actual Heat Transfer coefficient is equal or more than expected overall heat transfer coefficient (in fouled conditions), the guarantee shall be deemed to be met.

3. TEST CONDITION

Vendor to ensure that the PHE's are sufficiently cleaned to remove clogging / debris before the conductance of PG test.

- Every effort should be made to conduct the test runs under specified conditions & within accuracy of instruments.

- Test to be conducted under steady state condition of operation specially load, temperature & flow rate conditions.

- Before carrying out the test, it should be ensured that all the equipment's are inworking condition.

- All instrument used for the test should have valid calibration certificate. All instruments shall be calibrated in an approved / NABL accredited test lab.

4.0 PREPARATION OF TEST:

Prior to the test, the vendor shall be given an opportunity to examine and familiarize themselves with all the apparatus with the PHE's and the piping involved. All parties to the test shall certify that the PHE's are in satisfactory condition for the test. All the ACW pumps, ECW pumps, Self-Cleaning strainers and Plate heat exchangers shall be in working condition.

5.0 CONSTANCY OF TEST CONDITIONS:

Any condition like flow rates , inlet & outlet temps of ECW & ACW side, whose variation may affect the test result shall be made as constant as far as possible before the test run begins and shall be maintained constant throughout the run. It is desirable to observe and record all reading for a brief period after the unit has attained steady conditions but before the formal readings of the run have begun.

6.0 DURATION OF TEST AND FREQUENCY OF READINGS:

The test runs shall continue for a period sufficiently long to ensure accurate and consistent results. 15 Minutes is usually sufficient for a single test run.

Time interval between readings:

a) Temperature : Every 2 Minutes
b) Differential Pressure : Every 2 Minutes
c) Flow Rate : Every 2 minutes

All observations shall begin simultaneously at the beginning of a test run and during this time reading shall be taken simultaneously for both the PHE's under the test.

7.0 INSTRUMENTS AND METHODS OF MEASUREMENTS:

7.1 **Temperature Measurement:**

The temperature of DMCW and ACW at inlet and outlet of PHE's shall be measured with Thermocouple / RTD / Temperature Gauge at accuracy not higher than + 0.1 degC.Temp gauge on the inlet side as well as on the outlet side shall be mounted on the pipeline, by the vendor.

7.2 **Measurement of Pressure Drop:**

The pressure drops are to be measured with the help of Pressure Gauges (to be installed for the purpose of the test only) across inlet and outlet of PHE. The accuracy of Pressure Gauge should not be higher than 0.1 MWC.

7.3 **Measurement of Flow Rate:**

TG PHE :

Measurement of the flow rate on the primary side & secondary side of the PHE's for TG Auxiliaries to be done by ultrasonic flow meter of **accuracy ±2% of FSD** . The total flow rate shall be equally divided into number of PHE in operation. To achieve the above mentioned accuracy with the flow meter, upstream and downstream pipe length of 10D/5D straight length without any obstacle (bends, tee, valve, reducer, expander etc) is required. If in actual site condition, above straight lengths are not available, appropriate correction factor in flow rate will be applied tocorrect the measured flow rate as per below Table 1. **Vendor to provide the correction factors**

Table 1

Sr no	TG PHE	SIDE MEASURED	AVAILABLE STRAIGHT LENGTH	CORRECTION FACTOR	OBSTACLES
		Primary			
		Secondary			
Vendor to provide the correction factors					

SG PHE :

Measurement of the flow rate on the primary side & secondary side of the PHE's for SG Auxiliaries to be done by ultrasonic flow meter of accuracy ±2% of FSD . The total flow rate shall be equally divided into number of PHE in operation. To achieve the above mentioned accuracy with the flow meter, upstream and downstream pipe length of 10D/5D straight length without any obstacle (bends, tee, valve, reducer, expander etc) is required. If in actual site condition, above straight lengths are not available, appropriate correction factor in flow rate will be applied tocorrect the measured flow rate as per below Table 2 . **Vendor to provide the correction factors.**

Table 2

	SG PHE	SIDE MEASURED	AVAILABLE STRAIGHT LENGTH	CORRECTION FACTOR	OBSTACLES
		Primary			
		Secondary			
Vendor to provide the correction factors					

8.0 CALIBRATION OF INSTRUMENTS:

All instruments shall be calibrated in an approved / NABL accredited test lab. The Calibration Certificate in original shall be carried by PG test team. Copy of calibration Certificates shall be submitted to NTPC before start of PG test.

9.0 EVALUATION OF TEST RESULTS:

9.1 **Pressure Drop:** *Complete evaluation method with formulae used to be provided by vendor* .

9.2 **Heat Transfer Coefficient** (Evaluation of Thermal Performance) *Complete evaluation method with formulae used to be provided by vendor*

9.3 : **Sample calculation** *for 9.1 & 9.2 to be provided by vendor.*

10.0 LOG sheet for Demonstration test of Inlet & Outlet temperatures of DM water on Primary & secondary side of Plate heat exchangers

Project: ----------

Duration: -------Minutes

a) Readings for primary (DMCW) side for TG auxillairy

Table 3

Time	Sr no	Pressure at inlet of PHE Kg/cm2 (g)	Pressure at outlet of PHE Kg/cm2 (g)	Pr drop	Q1 Noted flow from the Ultrasonic flow meter m3/hr	T1 Temp at Inlet to PHE (°C)	T2 Temp at Outlet toPHE (°C)	Heat Load Kcal/hr (H1)	LMTD (°C)	Actual OHTC Kcal/ Hr.m2°C (Km)	Expected OHTC Kcal/ Hr.m2° C (Ke))

Note: Readings to be taken at taken intervals of 2 minutes for each PHE

b.Readings for secondary (ACW)Side of PHE's for TG Auxiliary

c. Readings for primary (DMCW) Side of PHE's for SG Auxiliary

d. Readings for secondary(AW) Side of PHE's for SG Auxiliary

Above same format to be repeated & attached as table 3 to for b,c,d.

11.0 Performance curves Drawing no ----------

Approved Correction curve from NTPC (Engg to)be attached along with transmittal

12.1 Technical datasheet Drwg no ----------

Approved Technical datashhet from NTPC (Engg to)be attached along with transmittal

PG TEST PROCEDURE FOR TG & SG PLATE HEAT EXCHANGER (PHE)

Station : ----------

Drawing no : ----------

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- All instrument used for the test should have valid calibration certificate. All instruments shall be calibrated in an approved / NABL accredited test lab.

4.0 PREPARATION OF TEST:

Prior to the test, the vendor shall be given an opportunity to examine and familiarize themselves with all the apparatus with the PHE's and the piping involved. All parties to the test shall certify that the PHE's are in satisfactory condition for the test. All the ACW pumps, ECW pumps, Self-Cleaning strainers and Plate heat exchangers shall be in working condition.

5.0 CONSTANCY OF TEST CONDITIONS:

Any condition like flow rates , inlet & outlet temps of ECW & ACW side, whose variation may affect the test result shall be made as constant as far as possible before the test run begins and shall be maintained constant throughout the run. It is desirable to observe and record all reading for a brief period after the unit has attained steady conditions but before the formal readings of the run have begun.

6.0 DURATION OF TEST AND FREQUENCY OF READINGS:

The test runs shall continue for a period sufficiently long to ensure accurate and consistent results. 15 Minutes is usually sufficient for a single test run.

Time interval between readings:

a) Temperature : Every 2 Minutes
b) Differential Pressure : Every 2 Minutes
c) Flow Rate : Every 2 minutes

All observations shall begin simultaneously at the beginning of a test run and during this time reading shall be taken simultaneously for both the PHE's under the test.

7.0 INSTRUMENTS AND METHODS OF MEASUREMENTS:

7.1 **Temperature Measurement:**

The temperature of DMCW and ACW at inlet and outlet of PHE's shall be measured with Thermocouple / RTD / Temperature Gauge at accuracy not higher than + 0.1 degC.Temp gauge on the inlet side as well as on the outlet side shall be mounted on the pipeline, by the vendor.

7.2 **Measurement of Pressure Drop:**

The pressure drops are to be measured with the help of Pressure Gauges (to be installed for the purpose of the test only) across inlet and outlet of PHE. The accuracy of Pressure Gauge should not be higher than 0.1 MWC.

7.3 **Measurement of Flow Rate:**

TG PHE :

Measurement of the flow rate on the primary side & secondary side of the PHE's for TG Auxiliaries to be done by ultrasonic flow meter of **accuracy ±2% of FSD** . The total flow rate shall be equally divided into number of PHE in operation. To achieve the above mentioned accuracy with the flow meter, upstream and downstream pipe length of 10D/5D straight length without any obstacle (bends, tee, valve, reducer, expander etc) is required. If in actual site condition, above straight lengths are not available, appropriate correction factor in flow rate will be applied tocorrect the measured flow rate as per below Table 1. **Vendor to provide the correction factors**

Table 1

Sr no	TG PHE	SIDE MEASURED	AVAILABLE STRAIGHT LENGTH	CORRECTION FACTOR	OBSTACLES
		Primary			
		Secondary			
Vendor to provide the correction factors					

SG PHE :

Measurement of the flow rate on the primary side & secondary side of the PHE's for SG Auxiliaries to be done by ultrasonic flow meter of accuracy ±2% of FSD . The total flow rate shall be equally divided into number of PHE in operation. To achieve the above mentioned accuracy with the flow meter, upstream and downstream pipe length of 10D/5D straight length without any obstacle (bends, tee, valve, reducer, expander etc) is required. If in actual site condition, above straight lengths are not available, appropriate correction factor in flow rate will be applied tocorrect the measured flow rate as per below Table 2 . **Vendor to provide the correction factors.**

Table 2

	SG PHE	SIDE MEASURED	AVAILABLE STRAIGHT LENGTH	CORRECTION FACTOR	OBSTACLES
		Primary			
		Secondary			
Vendor to provide the correction factors					

8.0 CALIBRATION OF INSTRUMENTS:

All instruments shall be calibrated in an approved / NABL accredited test lab. The Calibration Certificate in original shall be carried by PG test team. Copy of calibration Certificates shall be submitted to NTPC before start of PG test.

9.0 EVALUATION OF TEST RESULTS:

9.1 **Pressure Drop:** *Complete evaluation method with formulae used to be provided by vendor* .

9.2 **Heat Transfer Coefficient** (Evaluation of Thermal Performance) *Complete evaluation method with formulae used to be provided by vendor*

9.3 : **Sample calculation** *for 9.1 & 9.2 to be provided by vendor.*

10.0 LOG sheet for Demonstration test of Inlet & Outlet temperatures of DM water on Primary & secondary side of Plate heat exchangers

Project: ----------

Duration: -------Minutes

a) Readings for primary (DMCW) side for TG auxillairy

Table 3

Time	Sr no	Pressure at inlet of PHE Kg/cm2 (g)	Pressure at outlet of PHE Kg/cm2 (g)	Pr drop	Q1 Noted flow from the Ultrasonic flow meter m3/hr	T1 Temp at Inlet to PHE (°C)	T2 Temp at Outlet toPHE (°C)	Heat Load Kcal/hr (H1)	LMTD (°C)	Actual OHTC Kcal/ Hr.m2°C (Km)	Expected OHTC Kcal/ Hr.m2° C (Ke))

Note: Readings to be taken at taken intervals of 2 minutes for each PHE

b.Readings for secondary (ACW)Side of PHE's for TG Auxiliary

c. Readings for primary (DMCW) Side of PHE's for SG Auxiliary

d. Readings for secondary(AW) Side of PHE's for SG Auxiliary

Above same format to be repeated & attached as table 3 to for b,c,d.

11.0 Performance curves Drawing no ----------

Approved Correction curve from NTPC (Engg to)be attached along with transmittal

12.1 Technical datasheet Drwg no ----------

Approved Technical datashhet from NTPC (Engg to)be attached along with transmittal

QUALITY PLAN

Quality Assurance and Quality Plan

1	Typical quality plan is enclosed in specification 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.
2	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.
3	All materials used for manufacture/ fabrication of the plate heat exchanger components shall be of tested quality.
4	Qualification of welding procedures and welders shall be as per ASME B&PV Code, Section-IX/applicable code.
5	During detailed engineering, the various shop test procedures for DP test, Hydro test, Light box test etc. shall be submitted by bidder along with the quality plan for BHEL/customer approval.
6	Plates cleaning agent, liquid penetrant and developer shall not contain any halogen.
7	Hydrotest shall be performed first by applying pressure at both sides of plate at the same time, then only to one side and finally only to other side. Fluorescent dye shall be used during the test for ease of leak detection.

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO : - PE-TS-999-179-W001	DATE: -
	CUSTOMER :		QP NO.: PE-QP-999-179-W001	DATE: 02/01/2024
	PROJECT:		PO NO.:	DATE:
	ITEM: PLATE HEAT EXCHANGER	SYSTEM: DMCW/ACW	SECTION:	SHEET 1 of 5

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	B/ C				D	M	B	C	
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 accredited 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 accredited lab
		Dimensions	MA	Measurement	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	Relevant material Std.	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	Relevant material Std.	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	
1.3	Gaskets	Dimensions	MA	Measurement	100%	Sample	Approved Drawings / Mfg. Drawings	Approved Drawings / Mfg. Drawings	Inspection Reports	√	P,V	V	V	Co-related mill TCs to be provided.
		Workmanship	MA	Visual	100%	Sample	No damage	No damage	Inspection Reports	√	P,V	V	V	

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	Sign & Date	Name		Sign & Date	Name
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Reviewed by:	Vishal Kumar Yadav	VISHAL KR. YADAV	Reviewed by:	Harish Kumar	HARISH KUMAR

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO : - PE-TS-999-179-W001	DATE: -
	CUSTOMER :		QP NO.: PE-QP-999-179-W001	DATE: 02/01/2024
	PROJECT:		PO NO.:	DATE:
	ITEM: PLATE HEAT EXCHANGER	SYSTEM: DMCW/ACW	SECTION:	SHEET 2 of 5

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	B/ C				D	M	B	C	
		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	
		Internal Soundness (For diameter >= 40 mm)	CR	UT	100%	100%	ASTM A 388	**See Remark - 3**	Inspection Reports	√	P,V	V	V	UT will be carried on raw material stage.
2.0	**IN PROCESS INSPECTION**													
2.1	HT PLATES	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	

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MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO : - PE-TS-999-179-W001	DATE: -
	CUSTOMER :		QP NO.: PE-QP-999-179-W001	DATE: 02/01/2024
	PROJECT:		PO NO.:	DATE:
	ITEM: PLATE HEAT EXCHANGER	SYSTEM: DMCW/ACW	SECTION:	SHEET 3 of 5

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	B/ C				D	M	B	C	
		Surface Defects and Cracks	CR	DP test	10%	2 %	Approved DP test procedure		DPT Report	√	P,V	W	V	**See Remark 2**
				Light Box Test/ Vacuum chamber test	100%	10%	Approved Light Box/Vacuum test procedure		Vacuum Test Report	√	P,V	W	V	**See Remark 2**
		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 4**
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/ TPI / NPCIL, EIL) approved WPS/PQR/WPQ 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	
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%	Approved DP test procedure		DPT Report	√	P,V	W	V	
2.6	PHE Structure	Dimension	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	-	

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Reviewed by:		VISHAL KR. YADAV	Reviewed by:	Harish Kumar	HARISH KUMAR

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MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO : - PE-TS-999-179-W001	DATE: -
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	PROJECT:		PO NO.:	DATE:
	ITEM: PLATE HEAT EXCHANGER	SYSTEM: DMCW/ACW	SECTION:	SHEET 4 of 5

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	B/ C				D	M	B	C	
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	
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	Hydro Test	100%	100%	Approved Hydro test procedure		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	Hydro Test	100%	100%	Approved Hydro test procedure		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 & Packing	Dry film thickness & shade, Packing	MA	Measurement & visual	100%	100%	Customer/BHEL Tech. Spec. / Approved Data sheets		Test Report	√	P,V	V	V	
REMARKS: -														

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MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO : - PE-TS-999-179-W001	DATE: -
	CUSTOMER :		QP NO.: PE-QP-999-179-W001	DATE: 02/01/2024
	PROJECT:		PO NO.:	DATE:
	ITEM: PLATE HEAT EXCHANGER	SYSTEM: DMCW/ACW	SECTION:	SHEET 5 of 5

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	B/ C				D	M	B	C	

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	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 shall be tested in presence of BHEL & Customer. H.T. Plates without defect only shall be accepted.
3.	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.
4.	BHEL reserves the right to conduct random & independent PMI inspection on PHE's Heat Transfer plates to ascertain the plate material.

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

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	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[7]
A.2	Gaskets	Y				Y							
A.3	Cover Plates (Front & Rear)	Y[1]				Y	Y[5]						
A.4	Tie Rods	Y[1]		Y[4]			Y[6]						
B	**HORIZONTAL CENTRIFUGAL PUMP**				Y	Y						Y[10]	
B.1	Casing	Y[1]		Y[4]		Y			Y[8]				
B.2	Impeller	Y[1]		Y[4]		Y				Y[9]			
B.3	Shaft	Y[1]		Y		Y	Y[6]			Y[9]			

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.

5 UT shall be done on plates with thickness >40 mm and for pressure parts plates 25 mm or above.

6 UT shall be done on shaft / tie rod with diameter 40 mm or above.

7 After pressing each HT plate shall be subjected 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.

9 Static and Dynamic Balancing shall be carried out on complete rotor assembly.

10 All pumps shall be tested at rated speed, for head, flow capacity, efficiency and power consumption for the entire operating range i.e. from shut off head to maximum flow. A minimum of 7 readings shall be taken to plot the curve, with one reading at design flow. Testing standard shall be HIS (Hydraulic Institute Standard) of USA.
Performance test shall be carried out with contract motor, wherever Liquidated Damages are to be ascertained based on performance test at shop.

11. For pipes, fittings, valves & RE joints refer QA chapters of LP Piping.

	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[7]
A.2	Gaskets	Y				Y							
A.3	Cover Plates (Front & Rear)	Y[1]				Y	Y[5]						
A.4	Tie Rods	Y[1]		Y[4]			Y[6]						
B	**HORIZONTAL CENTRIFUGAL PUMP**				Y	Y						Y[10]	
B.1	Casing	Y[1]		Y[4]		Y			Y[8]				
B.2	Impeller	Y[1]		Y[4]		Y				Y[9]			
B.3	Shaft	Y[1]		Y		Y	Y[6]			Y[9]			

NOTES

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4 100% DPT shall be carried out on machined surfaces.

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9 Static and Dynamic Balancing shall be carried out on complete rotor assembly.

10 All pumps shall be tested at rated speed, for head, flow capacity, efficiency and power consumption for the entire operating range i.e. from shut off head to maximum flow. A minimum of 7 readings shall be taken to plot the curve, with one reading at design flow. Testing standard shall be HIS (Hydraulic Institute Standard) of USA.
Performance test shall be carried out with contract motor, wherever Liquidated Damages are to be ascertained based on performance test at shop.

11. For pipes, fittings, valves & RE joints refer QA chapters of LP Piping.

PAINTING REQUIREMENT

1	Stainless Steel, Non- Ferrous and Galvanised item/portion will not be painted.
2	Painting on steel surfaces/parts shall be as per below table and all exposed External surface coating shall confirm to C-4 as per ISO 12944.

Sl no	Condition	Surface Preparation	Primer Coat	No. of Coats	DFT (Microns)	Intermediate Coat	No. of Coats	DFT (Microns)	Final Coat	No. of Coats	DFT (Microns	Total DFT
1	Indoor	S.A 2.5 of Swedish Specification no. SIS-05-5900-1967	Chlorinated rubber based zinc phosphate primer	1	50	Chlorinated rubber based paint pigmented with Titanium dioxide	1	50	Chlorinated rubber paint	1	50	150
2	Outdoor	S.A 2.5 of Swedish Specification no. SIS-05-5900-1967	Epoxy resin based zinc phosphate primer	1	100	Epoxy resin based paint pigmented with Titanium dioxide	1	100	Epoxy paint suitable pigmented with DFT of 75 microns. Additionally finishing coat of polyurethane of minimum DFT of 25 microns	1	100	300

PACKING REQUIREMENT

Sl.no	DESCRIPTION
1	**Type of Packing:**
1.1	Item shall be fully covered with multi layered cross laminated colourless polyethylene sheet of at least 100 GSM and shall be packed inside wooden box or crate or fixed on wooden pallet depending upon the size.
1.2	Item shall be firmly fixed to the bottom of the packing box/crate/pallet with the help of supports/blocks to arrest the movement from all sides. The branch pipe ends and all opening shall be protected with polyethylene blind end caps.
1.3	Loose items/accessories like nipples, expander/reducer, root valves etc. shall be separately packed with polyethylene sheet of at least 100 GSM inside the packing box/crate.
2	**Quality of wood:**
2.1	**Quality of wood:** Wood used for packing box shall be Pinewood, Rubber wood, Mango wood, Fir wood, Silver Oak wood or other as per availability with moisture content not exceeding 30%.
3	**Cushioning material and moisture absorber:**
3.1	Suitable cushioning shall be provided by rubberized coir/ thermocol / expanded soft polyethylene foam.
3.2	Adequate quantity of packed desiccant shall be suitably placed inside the packing box.
4	**Packing slip & holder:**
4.1	Packing slip kept in polyethylene bag shall be placed inside the wooden box at appropriate
4.2	One copy of packing slip wrapped in polyethylene bag covered in galvanized iron tin sheet/ aluminium packing slip holder shall be fixed on the external surface the packing box.

BILL OF QUANTITY

2X800 MW LARA TPS

SL NO	ITEM DESCRIPTION	UOM	TOTAL QTY.
1.0	**Main Supply:**		
1.1	PHEs for DMCW-TG Aux's	Nos	6
1.2	PHEs for DMCW-SG Aux's	Nos	6
2.0	**Mandatory Spares:**		
2.1	**Mandatory Spares for PHEs for DMCW-TG Aux's**		
2.1.1	Plate Gaskets	Lot	150 nos
2.1.2	Fasteners including Tightening Bolts/Rods & Nuts	Lot	01 Set
2.1.3	Plates	Lot	150 nos (main plates) + 2 nos of end plates
2.2	**Mandatory Spares for PHEs for DMCW-SG Aux's**		
2.2.1	Plate Gaskets	Lot	150 nos
2.2.2	Fasteners including Tightening Bolts/Rods & Nuts	Lot	01 Set
2.2.3	Plates	Lot	150 nos (main plates) + 2 nos of end plates
3	**Lumpsum Site Performance Testing of all PHE's.**	Nos	12

One (1) set consists of quantity required for complete replacement for one (1) PHE of each type & size

BILL OF QUANTITY

2X800 MW SINGRAULI TPS

SL NO	ITEM DESCRIPTION	UOM	TOTAL QTY.
1.0	**Main Supply:**		
1.1	PHEs for DMCW-TG Aux's	Nos	6
1.2	PHEs for DMCW-SG Aux's	Nos	6
2.0	**Mandatory Spares:**		
2.1	**Mandatory Spares for PHEs for DMCW-TG Aux's**		
2.1.1	Plate Gaskets	Lot	150 nos
2.1.2	Fasteners including Tightening Bolts/Rods & Nuts	Lot	01 Set
2.1.3	Plates	Lot	150 nos (main plates) + 2 nos of end plates
2.2	**Mandatory Spares for PHEs for DMCW-SG Aux's**		
2.2.1	Plate Gaskets	Lot	150 nos
2.2.2	Fasteners including Tightening Bolts/Rods & Nuts	Lot	01 Set
2.2.3	Plates	Lot	150 nos (main plates) + 2 nos of end plates
3	**Lumpsum Site Performance Testing of all PHE's.**	Nos	12

One (1) set consists of quantity required for complete replacement for one (1) PHE of each type & size

DOCUMENTATION REQUIREMENT

Drawings & documents to be submitted by all the bidders along with the bid

Sl. No.	Document title
1	PQR credentials
2	Compliance sheet (duly signed & stamped)
3	Perforamce Gurantee schedule (duly signed & stamped)
4	Thermal sizing calculations (only for reference and shall be reviewed during detailed engineering).
5	GA drawing 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).

Drawings & documents to be submitted by successful bidder after award of contract along with submission schedule

Sl. No.	Document title	Submission schedule
1	Technical Datasheet & GA drawing - PHE	Within 15 days from LOI/PO
2	Thermal Sizing Calculation - PHE	Within 15 days from LOI/PO
3	QAP - PHE	Within 15 days from LOI/PO
4	Performance Curves - PHE	Within 15 days from LOI/PO
5	O & M Manual - PHE	Within 15 days from approval of above (Sl. No. 1 to 4) PHE documents.
6	PG Test Procedure - PHE	Within 15 days from approval of above (Sl. No. 1 to 4) PHE documents.
BHEL/Customer comments/approval and Vendor Re-submission schedule		
1	BHEL comments on first submission	Within 10 days of Vendor submission.
2	BHEL/Customer comments/approval on revised	Within 18 days of Vendor submission.
3	Vendor Re-submission	Within 7 days of BHEL / Customer comments.

Performance curves and figures to be furnished during contact stage

a)	Primary side water outlet temperature vs. Secondary side water inlet temperature.
b)	Primary side water flow (80% to 115%) vs. Pressure drop and outlet temperature (Secondary side flow – 100%)
c)	Secondary side water flow (80% to 115%) vs. Secondary side pressure drop and primary side outlet temp (Primary side flow – 100%)
d)	Primary side water outlet temperature vs. Primary side inlet temp.
e)	Film heat transfer coefficient curve
f)	Correction Curves.

Drawings & documents to be submitted as final/as-built document

Sl. No.	Document title
1	Approved documents
2	O&M Manual
3	All test certificates / reports
4	Drawings of components and details as deemed necessary.
5	Storage instructions

PRE QUALIFICATION REQUIREMENT (TECHNICAL)

FORM NO. PEM 6100-0

ENQUIRY NO.:

PROJECT: 2X800 MW NTPC LARA AND 2X800 MW NTPC SINGRAULI PROJECTS

PACKAGE: PLATE HEAT EXCHANGER (PHE)

1. The bidder should have designed, manufactured, tested, inspected & supplied the PHE with minimum heat load of 2469240 Kcal/Hr, which have been successfully in use for at least 1 year in thermal power plant or similar industry/ application and bidder is in business of PHE on continuous basis.

2. Offers of the JV companies/ Joint Bidders/ bidders having collaboration / licensing agreement/ MOU/ Indian subsidiaries meeting the PQR at sl. no. 1 above shall be evaluated as follows:

   a. If bidder happens to be an Indian subsidiaries of foreign OEM, then the credentials of the foreign OEM can also be considered for meeting PQR.

   b. If bidder happens to be the Joint Venture Company, then the credentials of any of JV partners can be also considered for meeting PQR.

   c. If bidder happens to bid jointly with their partner, then credentials of both the partners will be considered for meeting PQR as per distribution of the work. In all such cases, lead bidder as specified in bid documents shall be responsible for overall execution of the contract and all guarantee/ warranty

   d. If bidder happens to be the having valid collaboration agreement/ MOU/ licensing agreement with some other company, then the credentials of collaborator/ MOU partner/ licensing company can also be considered for meeting PQR.

Notes:

i) Bidder quoting on above route(s) should be manufacturer of PHE and qualifying on the basis of credentials of his principal/ JV partner/ Collaborator/ MOU partner/joint bidder/licensing Company etc., then the principal/ JV partner/ Collaborator/ MOU partner/ joint bidder/ licensing Company shall be responsible for overall design vetting and warranty/ guarantee of the package. The scope matrix clearly defining their respective roles including design vetting, manufacturing of critical component, E&C etc. and warranty/ guarantee shall be submitted along with the offer.

ii) Bidder to note that the arrangement of bidding (joint bid partners/ collaborator/ MOU partner/ licensing company etc.) once offered to BHEL as a part of bidding documents cannot be changed till the execution of the project.

3. The Bidders shall furnish following support documents for assessment of Bidder w.r.t. PQR as indicated at Sl. No. 1 above:

   A. Bidder's Experience list of PHE for last 5 years (as on the enquiry/NIT date) for assessment of bidder for supplying the PHE on regular basis for

establishing business continuity in the enclosed format- Annexure-1.

Bidder shall furnish the PO copy of at least one executed Contract as indicated in the experience list.

B. Bidder shall furnish any one from below in support of successful performance of PHE for one year:

i. Satisfactory Performance feedback certificates from End Customer (Owner) (in English) for at least one successfully executed contract which has been in use for at least one year indicating salient features like year of commissioning of PHE, rating of project, flow & heat load of PHE, project name etc., date of issue of certificate and name/ designation of the certificate issuer for power plant/similar application industry. The time duration of satisfactory performance completion should be before the date of subject enquiry/NIT.

OR

ii. The bidder has been awarded one repeat contract for PHE from End Customer (Owner) / Purchaser (in English) for power plant/similar application industry. Repeat contract shall be considered when the second contract is given by the same purchaser/ owner after lapse of minimum 1 year from execution (viz. supply) of first contract. Supporting documents for execution of the first contract like dispatch[N2] details or commissioning report or PG test report along with the PO Copy to be furnished, if bidder intends to submit the documents for Repeat Contracts. The date of repeat contract order should not be later than the date of subject enquiry/NIT.

Notes:-

N1 - Purchase order copy, supporting drgs/technical data sheets etc. are to be submitted along with the bid for which the bidder intends to furnish the performance feedbacks / repeat contracts for reference purpose only.

N2 - Dispatch details shall include any one of the following documents:
a. Tax Invoice.
b. Site receipt/Receipted LR.
c. Customer's material dispatch clearance certificate.

N3 – Purchase order for spare items shall not be considered as repeat order qualifying criteria.

Any additional document required in support of above documents to establish the co-relation between the above documents and the supplied item shall be provided by the bidder.

4. Bidder to submit all supporting documents in English. If documents submitted by bidder are in language other than English, a self-attested English translated document should also be submitted.

	5.	Notwithstanding anything stated above, BHEL reserves the right to assess the capabilities and capacity of the bidder/collaborators to perform the contract, should the circumstances warrant such assessment in the overall interest of BHEL.
	6.	After satisfactory fulfilment of all the above criteria/ requirement, offer shall be considered for further evaluation as per NIT and all the other terms of the tender.
	7.	Consideration of offer shall be subject to Customer's approval of bidder, as applicable as per NIT. Bidder to furnish the filled Sub-vendor questionnaire along with supporting documents/credentials as per Annexure-2.

EXPERIENCE LIST

ANNEXURE-1											
EXPERIENCE LIST											
PROJECT NAME	END CUSTOMER	PHE PARAMETERS			HEAT TRANSFER AREA (sq.m.)	PHE MODEL NUMBER	No. OF PHE's SUPPLIED	TYPE OF FLUID	PLATE MATERIAL	YEAR OF SUPPLY	PERFORMANE FEEDBACK CERTIFICATE ENCLOSED (Y/N)
		FLOW (Cu M/Hr.)	TEMP RISE (Deg. Cel.)	HEAT LOAD							

CORPORATE QUALITY ASSURANCE
SUB-VENDOR QUESTIONNAIRE

i.	***Item/Scope of Sub-contracting***	
ii.	***Address of the registered office***	***Details of Contact Person (Name, Designation, Mobile, Email)***
iii.	***Name and Address of the proposed Sub-vendor's works where item is being manufactured***	***Details of Contact Person: (Name, Designation, Mobile, Email)***
iv.	***Annual Production Capacity for proposed item/scope of sub-contracting***	
v.	***Annual production for last 3 years for proposed item/scope of sub-contracting***	
vi.	***Details of proposed works***	
1.	***Year of establishment of present works***	
2.	***Year of commencement of manufacturing at above works***	
3.	***Details of change in Works address in past (if any)***	
4.	***Total Area***	
	Covered Area	
5.	***Factory Registration Certificate***	***Details attached at Annexure – F2.1***
6.	***Design/ Research & development set-up (No. of manpower, their qualification, machines & tools employed etc.)***	***Applicable / Not applicable if manufacturing is as per Main Contractor/purchaser design) Details attached at Annexure – F2.2 (if applicable)***
7.	***Overall organization Chart with Manpower Details (Design/Manufacturing/Quality etc)***	***Details attached at Annexure – F2.3***
8.	***After sales service set up in India, in case of foreign sub-vendor (Location, Contact Person, Contact details etc.)***	***Applicable / Not applicable Details attached at Annexure – F2.4***
9.	***Manufacturing process execution plan with flow chart indicating various stages of manufacturing from raw material to finished product including outsourced process, if any***	***Details attached at Annexure – F2.5***
10.	***Sources of Raw Material/Major Bought Out Item***	***Details attached at Annexure – F2.6***
11.	***Quality Control exercised during receipt of raw material/BOI, in-process , Final Testing, packing***	***Details attached at Annexure – F2.7***

CORPORATE QUALITY ASSURANCE
SUB-VENDOR QUESTIONNAIRE

12.	***Manufacturing facilities*** ***(List of machines, special process facilities, material handling etc.)***	***Details attached at Annexure – F2.8***
13.	***Testing facilities*** ***(List of testing equipment)***	***Details attached at Annexure – F2.9***
14.	***If manufacturing process involves fabrication then-***	***Applicable / Not applicable***
	List of qualified Welders	***Details attached at Annexure – F2.10***
	List of qualified NDT personnel with area of specialization	***(if applicable)***
15.	***List of out-sourced manufacturing processes with Sub-Vendors' names & addresses***	***Applicable / Not applicable*** ***Details attached at Annexure. –F2.11*** ***(if applicable)***
16.	***Supply reference list including recent supplies***	***Details attached at Annexure – F2.12*** ***(as per format given below)***

Project/ package	*Customer Name*	*Supplied Item (Type/Rating/Model /Capacity/Size etc)*	*PO ref no/date*	*Supplied Quantity*	*Date of Supply*

17.	***Product satisfactory performance feedback letter/certificates/End User Feedback***	***Attached at annexure - F2.13***
18.	***Summary of Type Test Report (Type Test Details, Report No, Agency, Date of testing) for the proposed product*** ***(similar or higher rating)*** ***Note:- Reports need not to be submitted***	***Applicable / Not applicable*** ***Details attached at Annexure – F2.14*** ***(if applicable)***
19.	***Statutory / mandatory certification for the proposed product***	***Applicable / Not applicable*** ***Details attached at Annexure – F2.15*** ***(if applicable)***
20.	***Copy of ISO 9001 certificate*** ***(if available)***	***Attached at Annexure – F2.16***
21.	***Product technical catalogues for proposed item (if available)***	***Details attached at Annexure – F2.17***

Name:		***Desig:***		***Sign:***		***Date:***	

Company's Seal/Stamp:-

COMPLAINCE CERTIFICATE

1	It is hereby confirmed that the complete technical specification has been read and understood. We confirm compliance to the tender specification including any prebid clarification and amendments issued prior to techno-commercial bid opening without any deviation.
2	It is hereby declared that any technical submittals which was not specifically asked by BHEL in NIT shall not to be considered as part of bid and shall not be evaluated by BHEL.

Signature of authorised Representative

Name and Designation :

Name & Address of the Bidder

Date

PRICE ADJUSTEMENT-PVC payment terms and conditions

The price adjustment provisions shall be applicable separately for price components relating to Supply of Equipment/Mandatory spare (as applicable), as per price break-up furnished by the Contractor in price schedule.

Price adjustment amounts towards aforesaid components of Contract Price shall be paid in the respective currencies of Contract(INR).

PVC payment shall be linked with Delivery period defined as per NIT terms & conditions. PVC shall be applicable only, during the extended period of contract (if any) after contractual completion period and for the portion of work delayed / backlog for the reasons not attributable to the Contractor.

The total amount of PVC payable shall not exceed 10 % of the BASIC contract value for respective order. Negative price variation (without any limit) shall be passed on to BHEL.

PRICE ADJUSTMENT FORMULA FOR SUPPLY AND MANDATORY SPARES –

The amount of price adjustment towards variable portion payable/recoverable on each shipment/despatch shall be computed as under:

EC = EC1 - EC0, EC1 will be computed as follows:

$EC1 = EC0 \{F + a \times A_1/ A_0 + Lb \times L_1/ L_0\}$

Where
EC = Adjustment to Ex-Works supply and mandatory spare Price Component expressed in the currency of The Contract (INR) payable to the contractor for each shipment/despatch.

EC1 = Adjusted Amount of Ex-Works supply and mandatory spare Price Component expressed in the currency of the Contract (INR) payable to the Contractor for each shipment/despatch.

EC0 = Ex-Works supply and mandatory spares Price expressed in the currency of the Contract (INR), shipment/despatch wise.

- "**F**" shall be fixed portion of the Ex-Works Component of the Contract and shall be considered as 0.15.

- "**a"** shall be co-efficient of major materials/items involved in the Ex-Works Component of the Contract Price and shall be considered as 0.6.

- 'A', shall be published price indices of corresponding major materials/items. For this purpose, indices available at Office of the Economic Advisor for Wholesale Price Index (WPI) of Stainless-Steel Coils, Strips & Sheets, (https://eaindustry.nic.in/)

- 'L' shall be per Other consumer price index number for industrial workers (All India Monthly Average) as published (https://rbi.org.in/Scripts/BS_ViewBulletin.aspx?Id=21024)

- 'Lb" shall be co-efficient for labour component in the Ex-Works Component of the Contract Price which shall be considered as 0.25.

Price Indices to be considered:

Material	Index	Base Year
Stainless-Steel Coils Strips & Sheets	WPI Index at Office of the Economic Advisor	2011-12
Industrial labour	Table No. 19, Sl. no.1 (RBI)	2016

For the indices, subscript '0' refers to indices of the month immediate after expiry of contractual delivery period.

Subscript '1' refers to indices as on month before actual delivery date/month of Shipment / despatch.

	PRE - QUALIFYING REQUIREMENTS
PROJECT:	**2 X 800 MW NTPC LARA STPS & 2 X 800 MW NTPC SINGRAULI TPP**
PACKAGE:	**HEAT EXCHANGERS(PLATE TYPE)**

CRITERIA FOR EVALUATION - FINANCIAL :

	Amount (in Rs.)
Average annual financial turnover value during any three out of last six Financial Years as on tender due date should not be less than	**11,37,00,000.00**

Rs.Eleven Crore Thirty Seven Lakh only

Notes:-

a) The bidder has to submit financial accounts (audited, if applicable comprising of Audit report, Balance Sheet, Profit & Loss A/c Statement and Notes/Schedules pertaining to Turnover/Sales/Revenue), for any three out of last six Financial Years (or from the date of incorporation, whichever is less) as on tender due date to review the above criteria. In case the incorporation of vendor is less than 3 years, average annual financial turnover shall be calculated based on available information as below:-

i) If the accounts are available for <= 1 Financial Year, the Average Annual Turnover shall be calculated based on available information divided by 1 (One).

ii) If the accounts are available for >1 but < = 2 Financial Years, the Average Annual Turnover shall be calculated based on available information divided by 2 (Two).

iii) If the accounts are available for >2 but <= 3 Financial Years, the Average Annual Turnover shall be calculated based on available information divided by 3 (Three).

b) Foreign bidder is to submit a latest report from reputed third party business rating agency like Dun & Bradstreet, Credit reform etc. in addition to the documents mentioned at point (a) above for review of above criteria.

c) Other Income shall not be considered for arriving at Annual Turnover/Sales.For evaluation purpose,turnover figure excluding taxes shall be considered.

d) For evaluation of foreign bidder, exchange rate (TT selling rate of SBI) as on scheduled date of tender opening (Part-I bid in case of two part bid) shall be considered.

e)Bidder who is 50% or above subsidiary of any other company including those registered outside India and does not meet any of the above Financial Criteria, such bidder may be qualified based on credentials of its holding company provided such holding company meets the above PQR criteria. In such case, the Bidder would be required to furnish a Letter of Support from its Holding Company, pledging unconditional and irrevocable financial support for the execution of the Contract by the Bidder in case of award.

f)In cases where audited results for the last financial year as on the date of Techno Commercial bid opening are not available, a Certificate would be required from CEO/CFO stating that the financial results of the Company are under audit as on the date of Techno-commercial bid opening and are not available.

2X800 MW LARA STPP STAGE-II

BOQ CUM UNPRICED SCHEDULE FOR PLATE HEAT EXCHANGER PACKAGE (PHE)

SL. No.	DESCRIPTIONS OF WORKS OR EQUIPMENT	HSN CODE	UOM	TOTAL QTY.	UNIT EX-WORKS PRICE (DULY PACKED) (INR)	TOTAL EX-WORKS PRICE (DULY PACKED) (INR)	FREIGHT CHARGES @ % OF TOTAL EX-WORKS	TOTAL PRICES (EX-WORKS + FREIGHT) (INR)	APPLICABLE GST RATE @ % ON (TOTAL EX-WORKS + FREIGHT) (INR)	TYPE OF GST (IGST/CGST + SGST/UTGST)	TOTAL F.O.R. SITE PRICE (INR)
1	2	3	4	5	6	7=5*6	8	9=7+8	10	11	12=9+10
A	Total Price for Design, manufacture, assembly, inspection and testing, at manufacturer's and / or his sub contractor's works, properly packed and painted for transportation and delivery of Plate Heat Exchangers along with mandatory spares complete with all accessories, special tools & tackles (if any), commissioning spares (if any), counter flanges with nuts, bolts, gaskets and coatings (wherever necessary), PG Testing as specified in the Technical specification No. PE-TS-508/512-179-W001 (Rev 00) .										
	Break up of 'A' above										
A.1	**PHEs for DMCW-TG Aux's**		NOS.	6							
A.2	**PHEs for DMCW-SG Aux's**		NOS.	6							
A.3	**Lumpsum price for following Mandatory spares (also specified in Data Sheet-A) Break-up as under:**										
A.3.1	**Mandatory Spares for PHEs for DMCW-TG Aux's**										
A.3.1.1	**Gaskets**		LOT	150 nos							
A.3.1.2	**HT Plates**		LOT	150 nos (main plates) + 2 nos of end plates							
A.3.1.3	**Fasteners including Tightening Bolts/Rods & Nuts**		LOT	01 Set							
A.3.2	**Mandatory Spares for PHEs for DMCW-SG Aux's**										
A.3.2.1	**Gaskets**		LOT	150 nos							
A.3.2.2	**HT Plates**		LOT	150 nos (main plates) + 2 nos of end plates							
A.3.2.3	**Fasteners including Tightening Bolts/Rods & Nuts**		LOT	01 Set							
	Total (A.1+A.2+A.3)										

B	DESCRIPTIONS OF WORKS OR EQUIPMENT	SAC CODE	UOM	TOTAL QTY.	UNIT PRICE FOR PG TEST (INR)	TOTAL PRICE FOR PG TEST (INR)	FREIGHT CHARGES @ % OF TOTAL EX-WORKS	TOTAL PRICES (EX-WORKS + FREIGHT) (INR)	APPLICABLE GST @ % (INR)	TYPE OF GST (IGST/CGST + SGST/UTGST)	TOTAL PRICE FOR PG TEST WITH GST (INR)
	Lumpsum Site Performance Testing of all PHE for TG Aux's. and PHE for SG Aux's		SET	12							

C	**Grand Total (A+B)**	

NOTES :

1) Bidder to note that total price indicated above at C shall be considered complete in all respect for the full scope defined and considering all terms and conditions agreed.

2) Quantities indicated above shall be known as Order Quantities. The variation in Quantity shall be as per NIT.

3) Unit prices quoted by bidder, as above, shall be binding for any quantity variation.

4) Price of commissioning & erection spares, special tools & tackles and other accessories not listed above shall be included in the price of PHE & shall be supplied with the PHE.

5) Price break up for items not asked are deemed to be included in Sl.no '**A**' of this price schedule.

6) Delivery shall be as per NIT

7) Wherever quantity has been specified as percentage (%), it shall mean percentage (%) of the total population of the PHE for the project, unless specified otherwise and the fraction will be rounded off to the next higher whole number.

8) Wherever the quantities have been indicated for each type, size etc., these shall cover all the items to be supplied and installed.

9) One (1) set consists of quantity required for complete replacement for one (1) PHE of each type & size.

2x800 MW NTPC SINGRAULI STPP

BOQ CUM UNPRICED SCHEDULE FOR PLATE HEAT EXCHANGER PACKAGE (PHE)

SL. NO.	DESCRIPTIONS OF WORKS OR EQUIPMENT	HSN CODE	UOM	TOTAL QTY.	UNIT EX-WORKS PRICE (DULY PACKED) (INR)	TOTAL EX-WORKS PRICE (DULY PACKED) (INR)	FREIGHT CHARGES @ % OF TOTAL EX-WORKS	TOTAL PRICES (EX-WORKS + FREIGHT) (INR)	APPLICABLE GST RATE @ % ON (TOTAL EX-WORKS + FREIGHT) (INR)	TYPE OF GST (IGST/CGST + SGST/UTGST)	TOTAL F.O.R. SITE PRICE (INR)
1	2	3	4	5	6	7=5*6	8	9=7+8	10	11	12=9+10
A	Total Price for Design, manufacture, assembly, inspection and testing, at manufacturer's and / or his sub contractor's works, properly packed and painted for transportation and delivery of Plate Heat Exchangers along with mandatory spares complete with all accessories, special tools & tackles (if any), commissioning spares (if any), counter flanges with nuts, bolts, gaskets and coatings (wherever necessary), PG Testing as specified in the Technical specification No. PE-TS-508/512-179-W001 (Rev 00) .										
	Break up of 'A' above										
A.1	**PHEs for DMCW-TG Aux's**		NOS.	6							
A.2	**PHEs for DMCW-SG Aux's**		NOS.	6							
A.3	**Lumpsum price for following Mandatory spares (also specified in Data Sheet-A) Break-up as under:**										
A.3.1	**Mandatory Spares for PHEs for DMCW-TG Aux's**										
A.3.1.1	**Gaskets**		LOT	150 nos							
A.3.1.2	**HT Plates**		LOT	150 nos (main plates) + 2 nos of end plates							
A.3.1.3	**Fasteners including Tightening Bolts/Rods & Nuts**		LOT	01 Set							
A.3.2	**Mandatory Spares for PHEs for DMCW-SG Aux's**										
A.3.2.1	**Gaskets**		LOT	150 nos							
A.3.2.2	**HT Plates**		LOT	150 nos (main plates) + 2 nos of end plates							
A.3.2.3	**Fasteners including Tightening Bolts/Rods & Nuts**		LOT	01 Set							
	Grand Total (A.1+A.2+A.3)										
B	**DESCRIPTIONS OF WORKS OR EQUIPMENT**	**SAC CODE**	**UOM**	**TOTAL QTY.**	**UNIT PRICE FOR PG TEST (INR)**	**TOTAL PRICE FOR PG TEST (INR)**	**FREIGHT CHARGES @ % OF TOTAL EX-WORKS**	**TOTAL PRICES (EX-WORKS + FREIGHT) (INR)**	**APPLICABLE GST @ % (INR)**	**TYPE OF GST (IGST/CGST + SGST/UTGST)**	**TOTAL PRICE FOR PG TEST WITH GST (INR)**
	Lumpsum Site Performance Testing of all PHE for TG Aux's. and PHE for SG Aux's		SET	12							
C	**Grand Total (A+B)**										

NOTES :

1) Bidder to note that total price indicated above at C shall be considered complete in all respect for the full scope defined and considering all terms and conditions agreed.

2) Quantities indicated above shall be known as Order Quantities. The variation in Quantity shall be as per NIT.

3) Unit prices quoted by bidder, as above, shall be binding for any quantity variation.

4) Price of commissioning & erection spares, special tools & tackles and other accessories not listed above shall be included in the price of PHE & shall be supplied with the PHE.

5) Price break up for items not asked are deemed to be included in Sl.no '**A**' of this price schedule.

6) Delivery shall be as per NIT

7) Wherever quantity has been specified as percentage (%), it shall mean percentage (%) of the total population of the PHE for the project, unless specified otherwise and the fraction will be rounded off to the next higher whole number.

8) Wherever the quantities have been indicated for each type, size etc., these shall cover all the items to be supplied and installed.

9) One (1) set consists of quantity required for complete replacement for one (1) PHE of each type & size.