1.0 GENERAL:

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 spares (if any), counter flanges with nuts, bolts, gaskets and coatings (wherever necessary), including special tools & tackles (if any), including site PG test as mentioned in this specification for:

**2X660 MW ENNORE SEZ STPP**

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. In the event of Contradictions between Section IA /Customer Specification (Appendix 1)/ Datasheet A (Section IB), the same shall prevail in the order as:
Customer Specification (Appendix 1), Section IA, Datasheet-A (Section IB).

2.0 SYSTEM DESCRIPTION:

2.1 The Plate Heat Exchanger are intended to be used in closed circuit DM cooling water circuit for Cooling Hot passivated DM Water by Auxiliary Cooling Water (Clarified Water).

2.2 Passivated DM Water is circulated through various auxiliary coolers of TG, in closed loop by means of pumps. This DM water picks up heat from different cooling equipment’s. Heat from DM water is transferred to auxiliary cooling water (Secondary side) thru’ the Plate Heat Exchangers covered under this specification.

2.3 The analysis of DM Water, Clarified Water (Auxiliary cooling water) to be handled by the Plate Heat Exchangers are given in Data Sheet-A.

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

3.0 SCOPE OF SUPPLY:

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

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

- (i) Suitable drain and vent connections for both primary (DMCW) and Secondary Water (Clarified Water) streams complete with isolation valves.
- (ii) Supporting arrangement complete with foundation plate channels, anchor bolts, nuts, sleeves, inserts etc.
- (iii) Lifting arrangement i.e., lifting lugs, eye bolts etc.
- (iv) Matching counter flanges with necessary bolts, nuts, and gaskets for all flanged terminal points, including for DMCW and ACW inlet/outlet nozzles.
(v) Inspection ports at the End plates of the PHE.
(vi) Other accessories as required to make PHE’s complete in all respects.
(vii) Commissioning spares, if any.
(viii) One Ratchet spanner for each type of PHE is included in bidder’s scope of supply.
(ix) Matching piece (Reducer/Expander) on DM Water Side (Primary) only, with coatings (as required), to match the PHE nozzle connection with connecting pipe size as indicated in Data Sheet. Matching piece (Flanged Reducer/Expander) on ACW Side (Secondary) shall be provided by BHEL.
(x) Mandatory spares as applicable as per data sheet A.

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

4.0 INSPECTION REQUIREMENTS

4.1 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.

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

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

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

5.0 PERFORMANCE GUARANTEE AND TESTING:

5.1 The PHE shall be guaranteed to meet the performance requirements specified in Section-II and also for trouble free operation after commissioning.

5.2 PG test requirements are specified in Datasheet-A. In case of any deficiency, the vendor shall rectify the same at site with no additional cost to BHEL. All duly calibrated instruments required for PG testing including for flow measurements shall be arranged by the bidder and taken back after the Test. The computation of flow by characteristics curve of Pumps for PG Testing of PHE’s shall not be permitted.

5.3 It is clarified that pressure gauges and temperature gauges are provided at each PHE inlet / outlet on both primary / secondary sides and bidder can install their calibrated instruments on these locations. It is further clarified that due to layout constraints flow
measuring instruments installation on pipe is not feasible. Bidder shall arrange the Ultra-sonic flow meter / similar type of instrument for PG testing.

5.4 At the time of performance testing, cleaning of the plates (if required) and instruments like pressure gauges, temp. Gauges, flow measuring instruments etc. shall be arranged by the bidder and no instruments shall be provided by BHEL for performance testing.

6.0 Documents to be submitted along with the offer:

a) Compliance certificate.
b) Guarantee Schedule.
c) Thermal sizing calculations.
d) GA Drg. of PHE indicating all-important details for Layout purpose, withdrawal space required for plates, weight of assembly, nozzle & matching piece details etc.

7.0 Document submission schedule after the award of contract shall be as below:

<table>
<thead>
<tr>
<th>PACKAGE</th>
<th>BHEL DRG NO</th>
<th>DRG TITLE</th>
<th>Drg Submission schedule</th>
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<tbody>
<tr>
<td>PLATE HEAT EXCHANGERS (PHE)</td>
<td>PE-V5-412-179-N001</td>
<td>Technical Data sheet of PHE</td>
<td>R-0 within 20 days from LOI/PO &amp; subsequent revisions within 10 days of comments received from BHEL.</td>
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<tr>
<td>Primary Documents - affecting Manufacturing/ Delivery Directly</td>
<td>PE-V5-412-179-N002</td>
<td>GA drawing of PHE</td>
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<td>PE-V5-412-179-N003</td>
<td>Thermal sizing calculation of PHE</td>
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<td>PE-V5-412-179-N005</td>
<td>QAP of PHE</td>
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<tr>
<td>Secondary Documents - NOT affecting Manufacturing/ Delivery Directly</td>
<td>PE-V5-412-179-N004</td>
<td>Performance curves of PHE</td>
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<td></td>
<td>PE-V5-412-179-N006</td>
<td>O&amp;M MANUAL for PHE</td>
<td>Within 30 days from MDCC</td>
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</table>

8.0 EXCLUSIONS:

The following are excluded from the bidder’s scope:

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

**CUSTOMER:**

**PROJECT TITLE:**

**SPECIFICATION NO.:** PE-TS-XXX-179-N001

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

**SECTION:** IIA

### SL. NO | COMPONENT & OPERATIONS | CHARACTERISTICS | CAT | TYPE/ METHOD OF CHECK | EXTENT OF CHECK | REFERENC E DOCUMEN T | ACCEPTANCE NORMS | FORMAT OF RECORD | AGENCY | REMARKS
--- | --- | --- | --- | --- | --- | --- | --- | --- | --- | ---
1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | D* | ** 10. |

### 1.0 RAW MATERIAL INSPECTION

#### 1.1 Frame Plates & Pressure Plates, Counter Flanges, Connection Lining Material, Top And Bottom Carrying Bar.

- **Physical Properties**
  - **MA Physical Test**
  - **App. Drg / Data Sheet**
  - **Relevant material spec.**
  - **Mill TC Or Lab Test Report**
  - **1/ Heat/He-at Batch**
  - **1/ Heat/He-at Batch**
  - **-do-**
  - **-do-**
  - **-do-**
  - **2,3 - 1**
  - **If co-related mill TCS are not available then check testing carried out by reputed lab**

#### 1.2 Heat Transfer Plates/Coils

- **Physical Properties**
  - **MA Physical Test**
  - **App. Drg / Data Sheet**
  - **App. Drg. / Data Sheet**
  - **Mill TC Or Lab Test Report**
  - **1/ Heat**
  - **1/ Heat**
  - **-do-**
  - **-do-**
  - **-do-**
  - **2,3 - 1**
  - **Co-related mill TCS to be provided. See Remark 1**

#### 1.3 Gaskets

- **Dimensions**
  - **MA Measurement**
  - **Sample**
  - **Approved Drawings**
  - **Inspection Reports**
  - **100%**
  - **100%**
  - **-do-**
  - **-do-**
  - **2,3 - 1**
  - **Co-related mill TCS to be provided.**

---

**LEGEND:**

- * RECORDS, UNIDENTIFIED WITH “TICK” (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
- **1:** BHEL
- **1**: SHALL BE CLEARED BY BHEL
- **2:** VENDOR
- **3:** SUB VENDOR
- **P:** PERFORM
- **W:** WITNESS
- **V:** VERIFICATION
- **AS APPROPRIATE**
- **CHP:** CUSTOMER SHALL IDENTIFY IN COLUMN “N” AS ’W’

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

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<td>Physical Test</td>
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<td>-do-</td>
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<td>-do-</td>
<td>√</td>
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<td></td>
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<td></td>
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<td>MA</td>
<td>Measurement</td>
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<td>IR</td>
<td>√</td>
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<td></td>
<td>Workmanship And Finish</td>
<td>MA</td>
<td>Visual</td>
<td>100% 100%</td>
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<td>-do-</td>
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<td>UT</td>
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<td>Approved drawing/ data sheet</td>
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<td>MA</td>
<td>Physical Test</td>
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<td>Relevant Material Spec.</td>
<td>Mill Tc Or Lab Test Report</td>
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<td>MA</td>
<td>Chemical Analysis</td>
<td>1 Sample per Heat 1 Sample per Heat</td>
<td>Approved drawing/ data sheet</td>
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<td>√</td>
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<td></td>
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<td>MA</td>
<td>Measurement</td>
<td>1 Sample per Heat 1 Sample per Heat</td>
<td>Approved drawing/ data sheet</td>
<td>Inspection Report</td>
<td>√</td>
<td>2.3 - 1</td>
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<td>MA</td>
<td>Visual</td>
<td>100% 100%</td>
<td>Approved drawing/ data sheet</td>
<td>No scratches, cracks etc.</td>
<td>-do-</td>
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<td>2 % or min. 100 nos. whichever is higher</td>
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<td>DPT Report</td>
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<td>CR</td>
<td>Light Box Test/ Vacuum chamber test</td>
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<td>100%</td>
<td>Manufacturer's Light Box/Vacuum test procedure (to be reviewed and approved by BHEL/Customer during contract stage)</td>
<td>Vacuum Test Report</td>
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<td>PMI test</td>
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<td>Verification</td>
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** 3: CUST. SHALL IDENTIFY IN COLUMN “N” AS ‘W’

**Cust. Doc.No.:**
**Rev.:**
**Cat.:**

**MANUFACTURER/MAIN-SUPPLIER:**

**SIGNATURE**

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

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<td>2.5</td>
<td>Weld joint of expander/reducer.</td>
<td></td>
<td>MA</td>
<td>Visual</td>
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<td>Approved Drawings</td>
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<td>100%</td>
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<td>Plate arrangement to flow diagram</td>
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<td>CR</td>
<td>Visual as per flow diagram</td>
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<td>Squeezing of threads on T/B</td>
<td>MA</td>
<td>Visual</td>
<td>100%</td>
<td>Approved Drawing / Data sheet</td>
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<td>a. Conformance to GA drg.</td>
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<td>-do-</td>
<td>-do-</td>
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<td>B. Dimensions, No. of Heat Transfer Plates, Workmanship &amp; finish</td>
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<td>-do-</td>
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<td>-do-</td>
<td>-do-</td>
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<td>3.2</td>
<td>Unbalanced hydrostatic pressure (Primary Side)</td>
<td>Leakage / strength of structure</td>
<td>MA</td>
<td>Hyd. Test</td>
<td>100%</td>
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<td>Hydro Test Report</td>
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<td>100%</td>
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<td>-do-</td>
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<td>Verification of reports</td>
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**REMARKS:-**

1. Original Mill TC’s to be furnished by vendor to BHEL representative during inspection stage. 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.

3. Reg. Dye Penetrant Test & Light Box Test: There shall be random witness by BHEL/ NTPC at Bidder’s works, in case any defect is found in any of selected % of plates, the whole lot shall be tested in presence of BHEL & Customer. H.T. Plates without defect only shall only be accepted.

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 third party like TUV/Lloyd & certificate shall be submitted for review of BHEL. BHEL reserves the right to conduct random & independent PMI inspection on PHE’s Heat Transfer plates to ascertain the plate material.
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