

OPEN TENDER CHECKLIST

Sl. No.	Document Name	Vendor Confirmation (Filled and Signed copy to be submitted along with Techno Commercial Offer)
01	Annexure A COVERING LETTER	Submitted ☐ Not Submitted ☐
02	Annexure B GENERAL TERMS & CONDITIONS (FOR GUIDANCE TO THE SUPPLIERS)	Submitted ☐ Not Submitted ☐
03	Annexure C, COMMERCIAL TERMS AND CONDITIONS	Submitted ☐ Not Submitted ☐
04	Annexure D PRICE OFFER FORMAT	Submitted ☐ Not Submitted ☐
05	Annexure E SPECIFICATION DEVIATION DISPOSITION REPORT	Submitted ☐ Not Submitted ☐
06	Annexure F CEBG	Submitted ☐ Not Submitted ☐
07	Annexure G Online SRF	Submitted ☐ Not Submitted ☐
08	ANNEXURE H INTEGRITY PACT	Submitted ☐ Not Submitted ☐
09	TECHNICAL SPECIFICATION ROS:6169 REV 00 DATED 27.06.2017	Submitted ☐ Not Submitted ☐
10	TECHNICAL SPECIFICATION ROS:6170 REV 00 DATED 27.06.2017	Submitted ☐ Not Submitted ☐
11	TECHNICAL SPECIFICATION ROS:4172 REV 00 DATED 23.06.2017	Submitted ☐ Not Submitted ☐
12	P & ID FOR RO – PWTS 1 WT 150 01043 REV 00	Submitted ☐ Not Submitted ☐
13	P & ID FOR RO – ETP 1-WT-060-01044 REV 00	Submitted ☐ Not Submitted ☐
14	P & ID BOQ FOR PWTS - ANNEXURE - A	Submitted ☐ Not Submitted ☐
15	P & ID BOQ FOR ETP - ANNEXURE - A	Submitted ☐ Not Submitted ☐
16	VENDOR LIST	Submitted ☐ Not Submitted ☐
17	SEAWORTHY PACKING SPEC. PE TS 888 100 A001 REV 00	Submitted ☐ Not Submitted ☐
18	QUALIFICATION REQUIREMENT RO SYSTEM ANNEXURE III,	Submitted ☐ Not Submitted ☐
19	MANDATORY SPARES ANNEXURE II.	Submitted ☐ Not Submitted ☐



Bharat Heavy Electricals Limited

Boiler Auxiliaries Plant

RANIPET – 632 406, Tamil Nadu, India

Purchase Department - Desalination

ANNEXURE A

Open Tender for DESIGN, MANUFACTURING, TESTING & SUPPLY OF RO SYSTEM FOR PWTS & ETP INCLUDING ALL ACCESSORIES FOR KECL TANZANIA 371.2MW CCP PROJECT (INTERNATIONAL ORDER)

Enquiry No.: 7770668E DATED 19-JUL--2017 (NIT_33778)

Due on: 17-AUG-2017

To All [Manufacturers only.](#)

Dear Sir,

Please submit your lowest quotation on FIRM PRICE, in duplicate subject to our terms & conditions in the various annexures attached and herein for the below listed materials so as to reach us on or before the due date by 2.00 p.m.

[Requirement with Delivery date-FOR SUPPLY:](#)

Enquiry Sl. No.	Description & material Code	Unit	Qty.	Delivery Date
001	RWT705160001 CARTRIDGE FILTERS FOR RO STAGE-1 WITH ELEMENTS AIR VENT, DRAIN VALVE & ETC ., AS PER TECHNICAL SPECIFICATION NO. ROS:6169 REV 00 DATED 27.06.2017 & ROS:4172 REV 00 DATED 23.06.2017	ST	3.00	30.01.2018
002	RWT705160002 RO STAGE-1 HIGH PRESSURE PUMP WITH VFD MOTOR ASSEMBLY & ACCESSORIES, AS PER TECHNICAL SPECIFICATION NO. ROS:6169 REV 00 DATED 27.06.2017 & ROS:4172 REV 00 DATED 23.06.2017	ST	3.00	30.01.2018
003	RWT705160003 RO-1 SKID CONSIST OF FRAME, RO PRESSURE VESSELS, VALVES, PIPING & ETC., AS PER TECHNICAL SPECIFICATION NO. ROS:6169 REV 00 DATED 27.06.2017, ROS:4172 REV 00 DATED 23.06.2017 & P&ID FOR PTWS :1-WT-150-01043 REV 00	ST	2.00	30.01.2018
004	RWT705160004 VALVES FOR LP & HP PIPING (SKID OUT SIDE) AS PER TECHNICAL SPECIFICATION NO. ROS:6169 REV 00 DATED 27.06.2017, ROS:4172 REV 00 DATED 23.06.2017 & P&ID FOR PTWS :1-WT-150-01043 REV 00	ST	1.00	30.01.2018



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Enquiry Sl. No.	Description & material Code	Unit	Qty.	Delivery Date
005	RWT705160005 INTER CONNECTING LP (SS 316 SCH.10) & HP PIPING (SKID OUT SIDE) FOR RO STAGE-1, AS PER TECHNICAL SPECIFICATION NO. ROS:6169 REV 00 DATED 27.06.2017, ROS:4172 REV 00 DATED 23.06.2017 & P&ID FOR PTWS :1-WT-150-01043 REV 00	ST	1.00	30.01.2018
006	RWT705160006 MEMBRANE FOR RO STAGE-1 SKID AS PER TECHNICAL SPECIFICATION NO. ROS: 6169 REV 00 DATED 27.06.2017.	ST	2.00	30.01.2018
007	RWT705160007ELECTRICAL CONTROL & INSTRUMENTATION FOR RO STAGE-1 AS PER TECHNICAL SPECIFICATION NO. ROS:6169 REV 00 DATED 27.06.2017, ROS:4172 REV 00 DATED 23.06.2017 & P&ID FOR PTWS :1-WT-150-01043 REV 00	ST	1.00	30.01.2018
008	RWT705160008 VFD PANEL FOR RO STAGE-1 HP PUMP AS PER TECHNICAL SPECIFICATION NO. ROS:6169 REV 00 DATED 27.06.2017, ROS:4172 REV 00 DATED 23.06.2017.	ST	1.00	30.01.2018
009	RWT705160009 CARTRIDGE FOR RO STAGE-2, WITH ELEMENTS, AIR VENT DRAIN VALVE & ETC., AS PER TECHNICAL SPECIFICATION NO. ROS:6169 REV 00 DATED 27.06.2017, ROS:4172 REV 00 DATED 23.06.2017.	ST	3.00	30.01.2018
010	RWT705160010 RO STAGE-2 HIGH PRESSURE PUMP WITH VFD MOTOR ASSEMBLY & ACCESSORIES AS PER TECHNICAL SPECIFICATION NO. ROS:6169 REV 00 DATED 27.06.2017, ROS:4172 REV 00 DATED 23.06.2017.	ST	3.00	30.01.2018
011	RWT705160011 RO-2 SKID CONSIST OF FRAME, RO PRESSURE VESSEL, VALVES, PIPING, ETC.,	ST	2.00	30.01.2018



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Enquiry Sl. No.	Description & material Code	Unit	Qty.	Delivery Date
	AS PER TECHNICAL SPECIFICATION NO. ROS:6169 REV 00 DATED 27.06.2017, ROS:4172 REV 00 DATED 23.06.2017 & P&ID FOR PTWS :1-WT-150-01043 REV 00			
012	RWT705160012 VALVES FOR LP & HP PIPING (SKID OUT SIDE) FOR RO STAGE-2, AS PER TECHNICAL SPECIFICATION NO. ROS:6169 REV 00 DATED 27.06.2017, ROS:4172 REV 00 DATED 23.06.2017 & P&ID FOR PTWS :1-WT-150-01043 REV 00	ST	1.00	30.01.2018
013	RWT705160013 LP (SS 316 SCH. 10) & HP INTER CONNECTING PIPING (SKID OUT SIDE) FOR RO STAGE-2, AS PER TECHNICAL SPECIFICATION NO. ROS:6169 REV 00 DATED 27.06.2017, ROS:4172 REV 00 DATED 23.06.2017 & P&ID FOR PTWS :1-WT-150-01043 REV 00	ST	1.00	
014	RWT705160014 MEMBRANE FOR RO STAGE-2 AS PER TECHNICAL SPECIFICATION NO. ROS:6169 REV 00 DATED 27.06.2017.	ST	2.00	
015	RWT705160015 ELECTRICAL, CONTROL & INSTRUMENTAION AS PER TECHNICAL SPECIFICATION NO. ROS:6169 REV 00 DATED 27.06.2017, ROS:4172 REV 00 DATED 23.06.2017 & P&ID FOR PTWS :1-WT-150-01043 REV 00	ST	1.00	
016	RWT705160016 VFD PANEL FOR RO STAGE-2 HP PUMP AS PER TECHNICAL SPECIFICATION NO. ROS:6169 REV 00 DATED 27.06.2017, ROS:4172 REV 00 DATED 23.06.2017 & P&ID FOR PTWS :1-WT-150-01043 REV 00	ST	1.00	
017	RWT705160017 CARTRIDGE FILER FOR ETP RO SYSTEM, WITH ELEMENTS , AIR VENT, DRAIN VALVE & ETC., AS PER TECHNICAL SPECIFICATION NO. ROS:6170 REV 00 DATED 27.06.2017 & ROS:4172 REV 00 DATED 23.06.2017	ST	3.00	



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Enquiry Sl. No.	Description & material Code	Unit	Qty.	Delivery Date
018	RWT705160018 ETP RO HIGH PRESSURE PUMP WITH VFD MOTOR ASSEMBLY & ACCESSORIES, AS PER TECHNICAL SPECIFICATION NO. ROS:6170 REV 00 DATED 27.06.2017 & ROS:4172 REV 00 DATED 23.06.2017	ST	3.00	
019	RWT705160019 RO SKID FOR ETP, CONSIST OF SKID FRAME, RO PRESSURE VESSEL, VALVES, PIPING & ETC., AS PER TECHNICAL SPECIFICATION NO. ROS:6170 REV 00 DATED 27.06.2017 & ROS:4172 REV 00 DATED 23.06.2017	ST	2.00	
020	RWT705160020 VALVES FOR ETP RO LP & HP PIPING (SKID OUT SIDE) AS PER TECHNICAL SPECIFICATION NO. ROS:6170 REV 00 DATED 27.06.2017, ROS:4172 REV 00 DATED 23.06.2017 & P&ID FOR ETP :1-WT-060-01044 REV 00	ST	1.00	
021	RWT705160021 INTER CONNECTING LP & HP (SS 316 SCH.10) PIPING FOR ETP RO (SKID OUT SIDE) AS PER TECHNICAL SPECIFICATION NO. ROS:6170 REV 00 DATED 27.06.2017, ROS:4172 REV 00 DATED 23.06.2017 & P&ID FOR ETP :1-WT-060-01044 REV 00	ST	1.00	
022	RWT705160022 RO MEMBRANE FOR ETP RO SYSTEM, AS PER TECHNICAL SPECIFICATION NO. ROS:6170 REV 00 DATED 27.06.2017.	ST	2.00	
023	RWT705160023 ELECTRICAL, CONTROLS & INSTRUMENTATION, AS PER TECHNICAL SPECIFICATION NO. ROS:6170 REV 00 DATED 27.06.2017, ROS:4172 REV 00 DATED 23.06.2017 & P&ID FOR ETP :1-WT-060-01044 REV 00	ST	1.00	



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Enquiry Sl. No.	Description & material Code	Unit	Qty.	Delivery Date
024	RWT705160024 VFD PANEL FOR ETP RO HP PUMP AS PER TECHNICAL SPECIFICATION NO. ROS:6170 REV 00 DATED 27.06.2017 & ROS:4172 REV 00 DATED 23.06.2017	ST	1.00	
025	RWT705160025 FRP TANK 5 CU.M CAPACITY FOR RO CIP CLEANING AS PER TECHNICAL SPECIFICATION NO. ROS:6169 REV 00 DATED 27.06.2017,	ST	1.00	
026	RWT705160026 RO CIP CARTRIDGE FILTER WITH ELEMENT, AIR VENT, DRAIN VALVE, AS PER TECHNICAL SPECIFICATION NO. ROS:6169 REV 00 DATED 27.06.2017,	ST	1.00	
027	RWT705160027 RO CIP FEED PUMP WITH MOTOR ASSEMBLY & ACCESSORIES AS PER TECHNICAL SPECIFICATION NO. ROS:6169 REV 00 DATED 27.06.2017,	ST	2.00	
028	RWT705160028 FOUNDATION BOLTS FOR PWTS & ETP EQUIPMENTS (CARTRIDGE FILTERS, HP PUMPS, RO-1&2 SKID, ETP RO SKID, CARTRIDGE FILTER, CIP FEED PUMP & GRP TANK ETC. AS PER TECHNICAL SPECIFICATION NO. ROS:6169 REV 00 DATED 27.06.2017 & ROS:6170 REV 00 DATED 27.06.2017	ST	1.00	
029	RWT705160029 COMMISSIONING SPARES AS PER TECHNICAL SPECIFICATION NO. ROS:6169 REV 00 DATED 27.06.2017 ROS:6170 REV 00 DATED 27.06.2017 & ROS:4172 REV 00 DATED 23.06.2017	ST	1.00	
030	RWT705160030 MANDATORY SPARES AS PER TECHNICAL SPECIFICATION NO. ROS:6169 REV 00 DATED 27.06.2017 ROS:6170 REV 00 DATED 27.06.2017 & ROS:4172 REV 00 DATED 23.06.2017	ST	1.00	



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Requirement with Delivery date-FOR SERVICES:

Enquiry Sl. No.	Description & material Code	Unit	Qty.	Delivery Date
031	RWT705160031 TECHNICAL ADVISORY SERVICES FOR PWTS- ERECTION STAGE CLEARANCE, COMMISSIONING, POST COMMISSIONING/ PG TEST AT KILWA SITE, AS PER TECHNICAL SPECIFICATION NO. ROS:6169 REV 00 DATED 27.06.2017, ROS:4172 REV 00 DATED 23.06.2017. (Technical assistance for maximum of fifteen days (comprising three visits & excluding travels and holidays) at Kilwa site for erection stage clearance, commissioning, post commissioning / PG test. Vendor to include travel to & fro charges, lodging, local conveyance etc., for the above.) ALSO VENDOR TO PROVIDE BREAK-UP PRICE FOR THE TECHNICAL ADVISORY SERVICES.	ST	1.00	Based on BHEL Request Basis
032	RWT705160032 TECHNICAL ADVISORY SERVICES FOR ETP - ERECTION STAGE CLEARANCE, COMMISSIONING, POST COMMISSIONING/PG TEST AT KILWA SITE AS PER TECHNICAL SPECIFICATION NO. ROS:6170 REV 00 DATED 27.06.2017 & ROS:4172 REV 00 DATED 23.06.2017 (Technical assistance for maximum of fifteen days (comprising three visits & excluding travels and holidays) at Kilwa site for erection stage clearance, commissioning, post commissioning / PG test. Vendor to include travel to & fro charges, lodging, local conveyance etc., for the above.) ALSO VENDOR TO PROVIDE BREAK-UP PRICE FOR THE TECHNICAL ADVISORY SERVICES.	ST	1.00	Based on BHEL Request Basis



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Enquiry Sl. No.	Description & material Code	Unit	Qty.	Delivery Date
OPTIONAL PRICE	RECOMMENDED SPARES FOR 2 YEARS O&M -LIST OF SPARES WITH PRICE BREAKUP TO BE FURNISHED NOTE: THIS ITEM WILL BE ORDERED IF REQUIRED ONLY AND THIS ITEM WILL NOT BE CONSIDERED FOR ARRIVING RANKING	SET	1.00	Ordered later if required
OPTIONAL PRICE	TECHNICAL ADVISORY SERVICES FOR ADDITIONAL VISIT (ONE VISIT CONSIST OF MINIMUM THREE DAYS EXCLUDING TRAVELS AND HOLIDAYS) WHICH INCLUDE TRAVEL TO & FRO CHARGES, LODGING, LOCAL CONVEYANCE ETC. ALSO VENDOR TO PROVIDE BREAK-UP PRICE FOR THE ADDITIONAL VISIT. NOTE: THIS ITEM WILL BE ORDERED IF REQUIRED ONLY AND THIS ITEM WILL NOT BE CONSIDERED FOR ARRIVING RANKING	SET	1.00	Ordered later if required

BIDDERS SHALL CAREFULLY READ THE FOLLOWING ANNEXURES / NOTES AND SHALL QUOTE THEIR BEST COMPETITIVE PRICE.

PLEASE REFER TO,

1. **ANNEXURE-B FOR GENERAL TERMS & CONDITIONS (FOR GUIDANCE TO THE SUPPLIERS)**
2. **ANNEXURE-C FOR COMMERCIAL TERMS AND CONDITIONS**
3. **ANNEXURE-D PRICE BID FORMAT FOR THE SUPPLY, SERVICES & OPTIONAL PRICES.**
4. **ANNEXURE-E SDDR FORMAT**
5. **ANNEXURE-F CEBG FORMAT**
6. **ANNEXURE-G ON LINE SUPPLIER REGISTRATION FORM**
7. **ANNEXURE-H INTEGRITY PACT.**

TECHNICAL ENCLOSURES AS PER FOLLOWINGS:

01. ROS: 6169 REV 00 DATED 27.06.2017 - TECHNICAL SPECIFICATION FOR PTWS,
02. ROS: 6170 REV 00 DATED 27.06.2017 - TECHNICAL SPECIFICATION FOR ETP
03. ROS: 4172 REV 00 DATED 23.06.2017 - E, C & I
04. P & ID FOR RO - PWTS 1 WT 150 01043 REV 00
05. P & ID FOR RO - ETP 1-WT-060-01044 REV 00
06. P & ID BOQ FOR PWTS - ANNEXURE - A
07. P & ID BOQ FOR ETP - ANNEXURE - A
08. VENDOR LIST 280617,
09. SEAWORTHY PACKING SPECIFICATION PE TS 888 100 A001 REV 00,
10. QUALIFICATION REQUIREMENT RO SYSTEM ANNEXURE III,
11. MANDATORY SPARES ANNEXURE II.



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Important Instruction to Bidders:

1. All the items will be procured from a single vendor only & all the Items will be compared on SET Basis & Order will be placed on a Single vendor who is the lowest (L1) on set basis. Hence please quote for all the complete items including services. Incomplete offers will be rejected.
2. Vendors shall go through the “Qualification Requirement” & furnish Qualification Data sheet duly filled in along with Techno-Commercial offer. Offers received without this requirement will be summarily rejected & such offers will not be processed further.
3. Price bid opening will be considered subject to techno commercial confirmation and acceptance by BHEL,Ranipet & also approval from our customer : M/s. KECL TANZANIA 371.2MW CPP PROJECT.

➤ TENDER SHALL BE SUBMITTED IN TWO PARTS AS REFERRED IN ANNEXURE-B.

➤ ANY REVISED OFFER(S) SENT BY VENDORS ON THEIR OWN, AFTER THE TENDER OPENING, WILL BE TREATED AS "UNSOLICITED OFFER". SUCH OFFERS WILL NOT BE CONSIDERED AND NECESSARY ACTION AS DEEMED FIT WILL BE TAKEN BY BHEL ON THOSE VENDORS. HENCE COMPETITIVE OFFER TO BE GIVEN IN THE ORIGINAL QUOTE ITSELF.

IMPORTANT NOTE:

TENDERS ARE INVITED THROUGH ELECTRONIC MODE FROM ELIGIBLE SUPPLIERS IN CASE OF OPEN TENDERS AND FROM SUPPLIERS TO WHOM THE ENQUIRY IS ADDRESSED IN CASE OF LIMITED / SINGLE TENDER.

THE OFFERS SHALL BE POSTED INTO THE SYSTEM BEFORE THE DATE AND TIME SPECIFIED IN THE TENDER.

THE OFFER SHALL BE SENT ON ~~SINGLE PART~~ / TWO PART / ~~THREE PART~~ BASIS AS SPECIFIED IN THE MAIN TENDER DOCUMENT.

BIDS SHALL BE SUBMITTED THROUGH E-PROCUREMENT PORTAL, <https://bheleps.buyjunction.in> OF M/s mJUNCTION SERVICES LIMITED WHO ARE OUR SOLUTION PROVIDER.

01) OFFERERS ARE REQUESTED TO CAREFULLY READ THE FOLLOWING CONDITIONS AND GIVE THIER SPECIFIC CONFIRMATION OF ACCEPTANCE IN TOTO.

2A) TIME IS THE ESSENCE OF CONTRACT.

2B) IN THE EVENT OF DELAY ON THE CONTRACT DELIVERY, LIQUIDATED DAMAGES (LD) WILL BE LEVIED.

2C) LD WILL BE LEVIED AT THE RATE OF 0.5 % PER WEEK OR PART THEREOF ON THE CONTRACT VALUE.

2D) THE LD CEILING WILL BE 10 %.

2E) LD WILL BE A MANDATORY CONDITION IN THE PURCHASE ORDER.

3) IF NO CONFIRMATION OR COMMENTS ARE INCLUDED IN THE INITIAL OFFER BY THE TENDERER, IN THE EVENT OF PLACEMENT OF ORDER, THE ORDER WILL BE RELEASED WITH THE STANDARD LD CONDITION GIVEN ABOVE.

4) THE CONDITION WILL BE INCLUDED IN THE ORDER WITHOUT ANY FURTHER REFERENCE TO THE OFFERER AND NO CHANGES WILL BE PERMISSIBLE, POST ORDER RELEASE.

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**ANNEXURE –B**  
**GENERAL TERMS & CONDITIONS**  
**(FOR GUIDANCE TO THE SUPPLIERS)**

**A] Submission of Offer**

**a) Invitation for bid**

Tenders are invited through electronic mode from eligible suppliers in case of open tenders and from suppliers to whom the enquiry is addressed in case of Limited / Single Tender.

The offers shall be posted into the system before the date and time specified in the tender.

The offer shall be sent on single part / two part / three part basis as specified in the main tender document.

Bids shall be submitted through e-Procurement portal, <https://bheleps.buyjunction.in>, of M/s mJunction Services Limited who are our solution provider.

**b) Hardware and Software requirements for participating in e-tender**

Requirement for participating in e-Procurement is as under:

- i) A Computer with internet connectivity (Internet Explorer Version 9 and above).
- ii) Digital Signature Certificate (Class 3- SHA2-2048 BIT- with both Signing and Encryption component separately).
- iii) JAVA (Version 1.8 Update 45).

**c) Instructions for Registered Suppliers**

For all types of tenders (Single / Limited / Open) an automated email alert regarding issue of the Tender will be sent by the e-procurement portal to all Suppliers registered with BHEL, Ranipet for the item/s for which the tender is issued.

In case of open tenders, Registered suppliers with registered DSC will have to login with their user id/password & DSC and search for the Open Tender. On clicking the “Interest” button, they will get attached to that particular Open Tender.

Registered suppliers without DSC will have to first register themselves in <https://bheleps.buyjunction.in> as new supplier by clicking the “New Supplier” button.

To know the procedure for obtaining Digital Signature Certificate (DSC), suppliers who are not having the DSC are advised to visit our website [www.bhel.com](http://www.bhel.com) → Tender Notifications → Sample Checklist.

**d) Instructions for new suppliers wishing to bid against open tenders**

New, unregistered suppliers wanting to bid against open tender/s will have to first register themselves in <https://bheleps.buyjunction.in> as new supplier by clicking the “New Supplier” button.

After entering the Income Tax Permanent Account Number (PAN) details and pressing “Enter”, they have to click the “Interested” button against the respective BHEL Unit for which they want to participate in the Open Tender and also fill up other relevant Company information as a one-time activity.

Then, a box for filling in a “preferred login id” will appear at the top of the page. After giving the “preferred login id” and then clicking the “Next” button, Supplier would have to map their DSC (which will be activated by M/s mJunction Services Limited), if available. Or else, by pressing “skip” button and selecting relevant procurement category from the list available in the next page and “agreeing” to the BHEL’s terms & conditions, user id and password will be generated/activated once in 2 hours and mailed to their registered

email id. Using this user id and password, Supplier has to login and map the Digital Signature Certificate they have purchased to their code. The DSC will then be activated by M/s mJunction Services Limited.

As required by the tender, the necessary documents have to be filled-in online, in the provided template. Additional documents required are to be scanned and uploaded as .pdf file. Suppliers are advised to take note that the maximum space that is provided for uploading the documents that are to be attached is 300 MB. However the size of an individual document cannot exceed 10 MB. For any clarification on submission of offer on line, attention of the Supplier/s is invited to our document “Supplier Manual” hosted in the home-page of the e-procurement portal. During normal business hours, helpline maintained by the service provider mJunction is available for clarifying any doubts of supplier/s. The helpline numbers are 09840704941 or 09500199108.

**Typical documents that would be required as part of tender submission would be**

- a) **Complete technical Offer** with details, catalogues, as applicable.
- b) **Un-priced bid** (i.e. Bid without the Price) as per given format, if any.
- c) **Filled-in BHEL’s Standard Terms & Conditions** as per Annexure enclosed with the Tender Document,
- d) **Deviation summary** submitted in two parts – giving the summary of technical deviations separately and the commercial deviations separately, if any and
- f) **Supporting documents** to substantiate equivalent material specifications / sections, where quoted for.
- g) Where asked for, **Client list** with their full address including detail of contact person with phone no., fax no. & e-mail ID (if any) to whom the same / similar items are supplied in the past two years. The date of supply may also be indicated, against each client.
- h) **Bidders who are not already registered with BHEL Ranipet** are requested to submit the Supplier Registration Form (SRF) online (<http://supplier.bhel.in/>) for evaluating and registering as an approved vendor. The Supplier Development Cell (SDC) of BHEL, Ranipet would process the SRF for evaluation / registering the Supplier.

Suppliers can also upload their credentials by way of submission of Performance certificate/s issued by their customer/s detailing the quantity supplied and specification along with the un-priced PO copies and proof of supply along with the offer.

**Technical acceptance of offer by BHEL shall be based on the evaluation of offer and the submitted documents.**

#### **Note**

- (i) The materials offered, shall conform to the specification and scope attached in the tender.
- (ii) In case the offered materials are not conforming to the Enquiry material Specification, such offers would not be considered for evaluation and would be rejected.

Where equivalent specifications are offered, considering such offers will be at the sole discretion of BHEL. Wherever alternative standards / specifications are offered by Bidder, the Bidder shall provide sufficient documentary evidence to ensure equivalence to the designated standards / specifications, failing which the offer would be considered as not technically acceptable and hence shall stand rejected.

- (iii) All taxes and duties payable as extra to the quoted price should be specifically stated in offers (as appearing in the online template).

Offer/s from within India shall be submitted along with CST & TIN No. / Tariff No. etc, failing which the purchaser will not be liable for payment of such taxes and duties. Our TIN No. 33024364741, CST No. 1141686/01.07.2014, BHEL ECC No. AAACB4146PXM008.

(iv) The un-priced bid shall be used to indicate relevant commercial terms such as scope of freight and insurance, applicability of duties and taxes etc. All Commercial terms are to be indicated clearly in the offer.

(vi) No changes shall be entertained once the bid is opened unless otherwise specifically agreed to in writing by BHEL.

(vii) Money values other than for those items appearing in the un-priced bid template shall not be indicated anywhere in the un-priced bid.

(viii) Time required for inspection (at Supplier's works), should be clearly given in terms of numbers of working days.

(x) **Offers sent by FAX / E-mail:** would not be entertained.

**Price Bid** in conformance with the specification and terms as given in the Un-Priced bid document.

**Caution:**

*The suppliers are severely cautioned to note that the price bid document accepts the price in figures only. It does not allow the supplier to write the value by words. Therefore all care shall be exercised by the supplier while filling in the figures. Once the price bid is opened no option is available for the supplier to retract the offer under any grounds. If a supplier, for any reason whatsoever approaches BHEL with a request for change in the price, it would be treated as going back on the offer submitted. In such cases, action would be initiated by BHEL for suspending further business dealings with such suppliers as per policy of BHEL which prevails at that point of time.*

**Foreign / Overseas suppliers are hereby informed that offers with differential currencies are not permitted for a given tender document.**

**Note**

(i) The price break-up should be in line with technical specification / scope of the tender. (Cost of material, packing charges, forwarding charges, freight and insurance charges shall be shown appropriately, as applicable).

(ii) Unless otherwise specified as a part of the tender condition, No Price Variation Clause will be entertained and No advance payment will be made by BHEL.

(iii) In case, there is a discrepancy in the term quoted in techno-commercial bid and price bid, the term as per the techno-commercial bid (Part I) shall hold good and the commercial term quoted in the Price Bid (Part II) shall not be considered.

(iv) In their own interest, all Tenderers are advised to double check their prices, applicable duties and taxes.

(v) The quotation should be valid at least for a period of 90 days from the tender opening date.

(vi) Indian bidders should submit the prices in Indian Rupees only.

(vii) Foreign bidders may submit their bid in foreign currency. The currency for quoting shall be selected from the drop-down menu provided.



(x) Indian Suppliers shall quote on FOR Destination basis only. Destination is BHEL, Ranipet Stores or BHEL Project Site as specified in the tender requirement. Foreign Suppliers shall quote on CFR Chennai Seaport Delivery and Insurance will be in BHEL's scope. No other delivery terms shall be acceptable. Shipment shall be arranged by the Seller on *Liner in / Liner out basis*. As per Government of India guidelines, BHEL Ranipet being a Government of India Undertaking the Bill of Lading shall be made with the Shipper as "Government of India". This shall be specifically confirmed by the Bidder.

(xi) Where the cargo is containerized, Container washing charges, stuffing charges and / or any other such charges would be to the account of the supplier, where the containers are to be stuffed at the works of the supplier.

## **B) Opening of Offers**

a) **Tenders can be submitted up to 1400 Hours on tender opening due date. Part I will be opened on the same day at 1430 Hours. Results of the tender opening will be available for viewing for upto 7 days from the date of opening.**

**b) Requests by Bidders for extension of due date will not be entertained by BHEL.**

c) Price Bid opening will be done through e-mode / Reverse Auction method ( English method) **which will be decided after techno-commercial bid evaluation is completed.** All tenderers would have to specifically give their acceptance for this in their bid/s.

## **Note**

(i) Bids including all enclosures and supporting documents like catalogues, pamphlets, etc., shall be provided in ENGLISH language only.

(ii) In exceptional circumstances, at its option, BHEL may consider extending the due date/s for the tender openings for reasons such as (but not limited to) paucity of offers etc. However, sufficient notice would be given by BHEL for such extension.

(iii) Deviations shall be summarized and provided in a "Deviation Statement", listing the points and the deviation against each point.

(iv) BHEL reserves the right to increase or decrease the tendered quantity and to order on more than one vendor at the lowest acceptable price to BHEL. In ordering on more than one source, the ratio of quantity split will be as specified in the tender terms.

If not explicitly specified, BHEL reserves the right to split the quantity of the enquiry as follows: 70% quantity being ordered on the original lowest bidder (L1) and balance 30% on the next higher bidder/s excluding H1, who accepts the L1 price. However, the final decision to split the order rests with BHEL only.

In the event that the other than L1 suppliers do not accept the L1 price, then the balance will be reverted to the original L1 and the original L1 shall be bound to accept the balance of the enquiry quantity kept reserved for order splitting. This decision would be given by BHEL within 60 days of the price bid opening.

Notwithstanding the quantum of split that may be indicated in the main body of the enquiry, bidders are advised to note that the splitting of the orders will be decided by BHEL after the evaluation of the techno-commercial and price bids.

(v) Offers for part quantities on item level basis are not acceptable to BHEL. While tenderers can quote for some or all the tendered items, no supplier shall quote for partial quantity of any given enquiry item. Such

partial offer would not be considered in the enquiry for that item. Suppliers are to note that the evaluation unless otherwise specified will be on item level and not for the tendered items as a whole.

### **C] Evaluation of Offers**

- a) The price bids including the impact price (if any) of the technically acceptable offers alone shall be opened.
- b) Offers with pre-conditions (like conditional discounts) for price are liable to be not considered / rejected. For evaluation such conditions would be removed and only the base offer would be considered for evaluation and comparison.
- d) In the event of any change in scope / quantity arising out of the discussions, offerers would be given a chance to submit their revised offer / Impact bids. The option for the revised offer / impact offer will be triggered by BHEL. The Supplier then will have the facility to feed-in the revised price / impact price as per the provision given by BHEL. The impact price can be positive or negative (or nil). The impact price option shall contain only the price addition / deletion for such change in the scope / quantities, over and above the original scope and price quoted. The original price quoted would remain unchanged. The total price would then be computed by the arithmetic addition of the original price and the impact price. Where BHEL gives the option of submitting the revised offer, the impact would be computed as the arithmetic difference of the revised price and the original price.
- e) For evaluating the overseas offers, CFR Chennai Sea Port price quoted will be taken into account. The cost to BHEL will be arrived at by loading the applicable customs duty project wise, insurance charges, inland transportation charges to BHEL stores and LC charges etc.,
- f) For suppliers within Tamil Nadu state, as per prevailing VAT Act, VAT input credit is currently 5%.
- g) BHEL reserves the right to reject without assigning any reasons / load any offer with factors other than already specified for such offers having deviations to BHEL Specifications, Standard Terms & Conditions at its discretion. The decision of BHEL in this regard shall be final.
- h) BHEL reserves the right to reject an offer due to unsatisfactory past performance during tender finalisation / execution of a contract at any of BHEL projects / units or if unsatisfactory performance report is received from the party/s referenced by the supplier at any time during tender finalisation.
- i) BHEL reserves the right to operate Purchase / Price preference to Government of India Undertakings, which shall be given as per the guidelines of Government of India given from time to time and / or relax the Terms and Conditions of the tender.
- j) For the purpose of comparing prices, tender prices shall be converted to Indian rupees and the conversion shall be made by using the TT Selling rate of State Bank of India (SBI) prevailing on the date of opening of Techno-Commercial / Unpriced bids. If the relevant day happens to be a bank holiday, then the forex rate as on the previous bank (SBI) working day shall be taken. This exchange rate will be followed till placement of order. Tenderers may please note that even if an impact price is taken as in (d) for purpose of price evaluation and arriving at the rank; the exchange rate will be taken as explained above.
- k) Unless otherwise specified, evaluation will be on individual line item basis only and ordering will be on respective L1 vendors.

l) BHEL reserves the right to conduct negotiations on the “Price” and “Other Commercial Terms and Conditions” with the lowest ranked offerer at any time after the bid opening but before the release of the Purchase Order and If so required by BHEL, Supplier may have to share their costing sheet with BHEL.

m) Bidders are required to confirm in writing in their techno-commercial document that other than themselves (the bidder) none of its group companies, concerns or affiliates etc., are participating in the tender either directly or indirectly or through any other agency under the same proprietor / common partner(s)/ common Directors. If during the evaluation of the bids it is found that the bidder has submitted the offer in violation of this condition then all the offers received from the group companies would stand rejected. If such relationship is found at a later date where the Purchase Order has been issued, then BHEL would cancel the Purchase Order and initiate suitable action/s under the contract/s including but not limited to invoking the Risk Purchase clause of the order and other applicable legal provisions / guidelines of BHEL including guidelines on suspension of business dealings. (Please see clause L sub-clause c).

#### **D] Execution of the Order**

a) BHEL will have the option to pre-inspect the materials at Supplier's works by BHEL's own inspector or by third party agency appointed by BHEL or BHEL's end customer/s. The mere act of the pre-dispatch inspection (PDI) does not absolve the Supplier from giving the specifications as agreed upon in the Purchase Order. In the case of inspection being carried out by a third party inspector (TPI) as per the extant practice, the TPI would forward the Inspection Report (IR) along with Test Certificates and other related documents to the Quality Assurance (QA) Department of BHEL. The QA department after scrutinising the report/s submitted by the TPI would issue the Material Dispatch Clearance Certificate (MDCC). Suppliers are hereby informed that materials should be dispatched only after getting the MDCC, failing which the materials may be rejected on receipt at BHEL Stores.

b) In the case of overseas suppliers Inspection call for carrying out the inspection shall be given 30 days before the scheduled contract delivery date. The Inspection date/s given by the Supplier shall be on firm basis. For local Suppliers the Notice period of Inspection shall be 10 working days.

c) Deviations, if any pointed out by the visiting Inspection team of BHEL shall be corrected and the items as per specification shall be dispatched on or before the contract delivery date after getting the MDCC.

d) The final inspection for acceptance will, however be carried out at BHEL's works at Ranipet.

**e) The contract delivery date is the date of receipt at BHEL Stores for suppliers in India, applicable in the case of FOR Destination Contracts.**

**For ex-works contracts or FOR dispatching station indigenous contracts, the date of the Lorry way bill issued by the authorised transport carriers of BHEL / Railway Receipt / Courier Way bill / Airway bill or any such dispatch documents of carriage approved by BHEL would be considered as the Contract Delivery Date. In the case of CFR contracts with overseas suppliers, the B/L date shall be taken as the Contract Delivery Date**

f) Travel & other local stay cost for the Inspectors sent by BHEL will be to BHEL account, but other Inspection Charges, if any shall be to the account of the Seller only.

g) The supplier shall arrange for packing suitably in all respects for normal transport by sea / rail / road and Materials shall be suitably protected against effect of tropical salt laden atmosphere in the event of shipment being delayed at ports / store yards and as per BHEL TDC.

h) Foreign suppliers shall dispatch on CFR agreed Sea-Port basis, according to the contract conditions. Indian suppliers shall dispatch on free delivery (door-delivery) at BHEL stores basis only. Unloading the materials at BHEL Stores would be to the account of BHEL only.

i) In the event of any short supply, it shall be the responsibility of the supplier to deliver such short supplied/ missing items on Free-of-Cost basis at BHEL stores, including customs clearances at Indian Ports in the case of foreign suppliers.

k) Terms of payment:

k.1) For Indigenous Suppliers: Unless otherwise agreed to by BHEL, the standard payment terms of BHEL shall be: For non-MSE suppliers 100% payment made directly through EFT within 90 days from the date of receipt and acceptance of materials at BHEL Stores, Ranipet or 90 days from the date of acknowledgement of receipt of materials at destination specified. If any supplier asks for payment terms other than the above specified, then suitable loading on cost will be considered. **Loading of any deviation in the payment terms w.r.t tender terms will be “Base rate of State Bank of India (SBI) (as applicable on the date of bid opening: Techno-commercial bid opening in case of two part bids) + 6%, will be considered for loading for the periods of relaxation sought by bidders.**

k.2) For MSE vendors (under Micro & Small category alone) 100% payment will be made within 45 days from the date of receipt and acceptance of materials at BHEL Stores, Ranipet or 45 days from the date of acknowledgement of receipt of materials at destination specified.

l) NOTE:

Where the destination specified is other than BHEL Stores Ranipet, for claiming payment, Supplier has to submit proof of receipt of the materials at the destination by furnishing a copy of the acknowledged despatch document (LR/RR/Courier receipt etc.) .

If the Bidder is bidding for the first time and wants to be considered as an MSE then, the Bidder shall submit document evidencing that they are an MSE along with a certificate from a Chartered Accountant certifying the status of their Unit / Works clearly specifying the address of the works which is to be considered as MSE and send the same to BHEL, Ranipet either before the tender opening date or upload it as a part of the tender document in the e-procurement portal. Where the document is submitted electronically a hard copy shall invariably be sent within a reasonable period (not exceeding 30 days) from the bid opening date for the purpose of BHEL's records. If the hard copy is not received within this specified time, then the supplier would be treated as a non-MSE. BHEL will not be responsible for any postal / courier / delivery delays.

For approved vendors the status as on the date of the bid opening as available with BHEL Ranipet's records shall be used for reckoning the status of the Bidder as an MSE or otherwise.

Offer/s received without these documents will be treated as non-MSE and order finalization will be done based on this premise. Documents submitted after Bid-opening will not be considered in this tender. This provision for MSE will apply subject to the condition that the participating MSE meets the tender requirements.

For approved suppliers, in case of any change in the MSE status, it shall be the responsibility of the Bidder to notify the change as a part of the Bid document. If at a later date it comes to the knowledge of BHEL, Ranipet that the change in the status has not been intimated by the Bidder and the order is obtained under the premise of an MSE then BHEL would cancel the pending order against this tender and take necessary steps

for suspension of the business dealing with the Bidder as per the procurement policy of BHEL. Similarly if a supplier claims MSE status after the Part I bid opening, then the same would not be considered in the tender.

In case after the bid opening it is seen that no MSE has become L1, then depending on the nature of the item, if it is not possible to split the tendered items / quantities on account of reasons like customer contract requirements of supplying one make for a given project or technical reasons like the tendered item being a system etc. then BHEL would not counter offer the L1 prices even though there may be MSE bidders within the +15% band of L1.

Other concessions for MSEs / Reserved sectors

In addition to the concessions specified above, MSE suppliers will be eligible for such other concessions as per the MSME Act 2006 and any other benefits / concessions that may be announced by the Government of India from time to time.. However, such concessions as applicable at the time of tender opening alone will be applicable. Any concessions advised after tender opening will not be considered for the current tender.

Items that are reserved for MSE and for any other items for which reservations for Indian manufacturers are notified by the Govt. Of India, such concessions as prevailing on the date of tender opening shall apply as a part of this tender conditions.

ii) Foreign Suppliers “100% thru’ irrevocable & unconfirmed LC at sight within 3 weeks from the PO date through any one of our Bankers listed elsewhere in the tender conditions for 100% value (less Agency Commission, if any ) valid up to the PO delivery period and 15 days thereafter for negotiation. All bank charges in India to BHEL's account and all other charges outside India to Supplier's account. **BHEL would load the price of foreign suppliers in order to bring them on common platform as per Indigenous Suppliers on the account of differential payment terms to Indigenous Suppliers. Loading of payment terms will be “Base rate of State Bank of India (SBI) (as applicable on the date of bid opening: Techno-commercial bid opening in case of two part bids) + 6%, will be considered for loading for the periods of relaxation compared to indigenous suppliers i.e. 90 days.**

m) Any incidence of tax like Income tax, Goods & Services Tax (GST) and Withholding any other similar tax / duties /levies imposed by the Government of India, or the State Government, where the BHEL Unit is located, deductible at Source, during the tenure of the Order shall be deducted by BHEL and necessary certification of the deduction (Tax deduction at Source) would be given. This is subject to the supplier fulfilling the necessary documentation as specified by the Government of India. (e.g. Tax Residency Certificate, PAN Number etc.)

n) The Guarantee period shall start from the “Date of receipt and acceptance of the materials at BHEL Stores.”

***o) Where any bidder gives extended credit period over and above that offered by BHEL, then all other Non-MSE bidders and foreign bidders would have to match the extended period of payment terms. This information would be given to such bidders after opening of the techno-commercial bids; but before opening the price bids. However bidders would not be allowed to change their price bid for purpose of confirming the extended credit period. In the event such bidder/s do not accept the extended credit period for payment, then their offer would be loaded to the extent of the differential between their offered payment terms and the revised payment terms offered by BHEL as explained above.***

**E] Liquidated Damages Clause:**

BHEL will levy penalty as Liquidated Damages (LD), for delay in delivery. The damages shall be at the rate of ½% per week or part thereof subject to a maximum of 10% PLUS applicable Goods & Services Tax (GST). The contract delivery date for purpose of L.D is the date of receipt at BHEL Stores for suppliers in India for F.O.R. Destination Contract and the date of dispatch clearance given by BHEL for overseas suppliers. For ex-works or F.O.R dispatching station contracts, the date of the dispatch document will be reckoned as the date of delivery for computing the LD. Supplier shall deduct the applicable LD from the first payment when raising the claim for the same. The applicable LD if any would be communicated by BHEL along with the dispatch clearance. It is taken by BHEL that Foreign Suppliers have confirmed their acceptance to BHEL for opening the LC for value which is the value of the order reduced by the applicable LD. The LD would apply on the undelivered portion only. In case of reasons attributable to BHEL for the delay in delivery (for e.g. delay in arranging the pre-inspection) then the delivery time would be reset to the extent of the time delay attributable to BHEL, with waiver of the LD. Delivery being the essence of BHEL's contract requirements, Unless otherwise specified the LD would apply on the undelivered portion of the contracted items. **In the event that a Supplier does not accept the LD condition above, the offer would be loaded to the extent of the shortfall with respect to upper limit specified above.**

## **F) Miscellaneous**

### **i) Role of Principals and Agents:**

BHEL will deal directly with indigenous manufacturers only.

BHEL strongly discourages the engagement of Agents in India by foreign principals, to deal with BHEL, in BHEL's tenders.

BHEL will not enter into any correspondence with an Indian Agent.

The Indian Agent will not be extended the privilege given to the principals, such as that of attending the tender openings, attending technical discussions, commercial discussions or price negotiations and such like.

In case, in spite of the above, a foreign principal insists on engaging an Indian Agent, It is made clear by BHEL that:

It is the sole responsibility of the foreign principal to ensure the Agent does not represent any other foreign principal in a given tender.

An undertaking to this effect shall be given by the foreign principal that his / her Agent does not represent any other foreign principal in the tender. This document shall form a part of the techno-commercial offer.

A Principal shall authorise only one Agent to quote against each BHEL's tender. In the event a Principal authorises more than one agent to quote against a BHEL's tender, then all such offers will be rejected by BHEL in that tender. Principals are also advised to include BHEL's tender Number / Reference in their authorisation issued to the Agent.

If at any stage of the tender, BHEL finds that an Indian Agent has represented more than one foreign principal, all such offers of and all the foreign principals would be disqualified summarily in the tender inquiry.

BHEL will only give an intimation of notice of the disqualification. No correspondence would be entertained by BHEL, on their decision. Such decision of BHEL shall be irrevocable, firm and final and shall be binding on the tenderer.

BHEL, due to business reasons would ban, would have banned Indian agents from dealing with BHEL.

Any foreign principal who engages such a banned agent, or an employee of the banned agency, or any other person connected with the banned agency, at any time during the tender proceedings, would be disqualified from the tender proceedings. The decision of BHEL in this regard shall be final and be binding on the OEM.

Hence in their own interests, prospective tenderers may check with BHEL, the status of their proposed agent vis-à-vis BHEL.

In view of the requirement of BHEL, it is strongly suggested that in their own interest, foreign principals may desist from engaging any Indian agent and deal with BHEL directly and it is stressed that any Main producer proposing to deal with BHEL by engaging and through an Indian Agent does so at their own risk.

BHEL shall in no way be responsible for any consequences that may arise to the foreign principal on account of the antecedents / actions of their Indian Agent.

**In the event of the foreign principal engaging an Indian Agent:**

**a) The Supplier shall furnish an authenticated copy of the Agency Agreement with his agent detailing the precise relationship between them and their mutual interest in the business along with techno-commercial bid.**

b) The Supplier shall furnish original authorization letter for the Indian Agent. The letter shall contain name, contact person, complete postal address including phone, fax and e-mail ID. It shall also spell out the type of services to be rendered by Indian Agent.

c) Indian Agent & Agency commission: An Indian Agent can represent only one Foreign Manufacturer against a particular Tender. The CFR price quoted by the foreign bidder shall include the agency commission. However, the agency commission component payable to their Indian Agents shall be shown separately in the Offer, either as a lump-sum or as a percentage of the quoted price. This will be paid by BHEL in Indian Rupees, on satisfactory receipt & acceptance of the materials. For calculation of Rupee equivalent of Agency Commission, exchange rate as prevailing on the date of Purchase Order will be taken and

d) For all discussions, technical clarification and negotiations etc. only the principal would be authorized for interaction with BHEL. The Agent shall not be a party to the discussions / negotiations and would not be normally allowed to participate.

**ii) Terms & Conditions of Letter of Credit (L/C) for overseas suppliers (indicated for acceptance).**

a) Unconfirmed irrevocable Letter of Credit at Sight only will be opened by BHEL. Confirmation of L/C is not preferred by BHEL. Also L.C will be opened in Lots in line with the staggered delivery.

b) All Bank charges out side India are to the Supplier's account and within India to BHEL's account.

c) In case of L/C extension caused by delays attributable to the Supplier, the L/C extension / commitment charges are to be borne by the Supplier.

**iii) Other terms & conditions for letter of credit: - Documents for negotiation**

a) Signed Commercial invoice in quadruplicate, for a value not exceeding the draft amount, quoting the import Licence No and certifying goods evidencing shipment of the merchandise are as per Applicant's Purchase Order. The amount of invoice after deducting Indian Agent's commission, if any, should not exceed the Credit amount. (The Indian agent's commission, if any, is payable in India in Indian rupees only.)



- b) Certificate of Country of Origin, from the country of manufacture, issued by the Chamber of Commerce.
- c) One set of Original and two sets of Non-negotiable copies of 'signed', 'unmarked', 'clean on board' Ocean Bill of Lading, showing Shipper as "Government of India" Account M/s. Bharat Heavy Electrical Ltd, Unit: BHEL, Ranipet as consignee (The opening bank should not be notified as consignee), marked freight payable / prepaid at destination.
- d) Packing list in 4 copies in English, indicating Size wise Number of bundles / pieces shipped and weight.
- e) Certified copy of the fax / e-mail sent by the beneficiary to the applicant giving the following particulars of shipment, as the insurance is to be arranged by the Applicant in India: (a) Purchase Order Number & date; (b) Bill of Lading Number & date (c) Name of vessel; (d) Port of Loading; (e) Number of bundles / pieces and weight; (f) Invoice Number, date and value (g) Purchase Order item number's despatched. The cable / fax is to be sent within 2 working days of shipment.
- f) Beneficiary's certificate showing the relevant airmail / courier reference no. and date that the following clauses have been complied with:
  - 1] Beneficiary to forward by Registered Airmail / Courier one complete set of original documents and one set of non-negotiable documents within 3 working days of obtaining shipping documents to Regional Manager (ROD), Bharat Heavy Electricals Ltd, 6th Floor, EVR Periyar Bldg. No 690 (Old 474), Anna Salai, Nandanam, Chennai-600035. India. (Phone: +91-24330931, 24330253; e-mail: pbpwar@bhel.in)
  - 2] Beneficiary to courier at his cost 3 copies of complete set of non-negotiable documents to the Officer who released the Purchase Order.
  - 3] Declaration by the Supplier certifying that the contents in each case are not less than those entered in the invoices / packing list and that the invoicing for the supplies effected is strictly in accordance with agreed rates as stipulated in the Purchase Order.
  - 4] Declaration to the effect that all other documents as per purchase order has been couriered to the Purchase order releasing authority
  - 5) The carrying steamer should be seaworthy, less than 25 years of age and approved by Lloyds / Classification Societies / General Insurance Corporation of India from time to time and
  - 6) Copy of Dispatch Clearance / Instruction issued by BHEL.

**iv) Documents to be sent directly to the Purchaser prior to shipment**

- a) Manufacturer's Original Internal Inspection / Test certificate in triplicate.
- b) Manufacturer's Original Guarantee certificate as per Purchase Order. The material shall be guaranteed for a period of 12 months from the date of acceptance of the materials at BHEL stores or 18 months from the date of dispatch whichever is earlier. The acceptance would be evidenced by the Stores Receipt Voucher (SRV) which will be raised by BHEL.
- c) Inspection / Test Certificate issued by BHEL / Inspection agency specified in the Purchase Order. In the event that Inspection prior to dispatch is not carried out by the Engineers of BHEL, the Inspection certificate of the third party so authorized by BHEL and
- d) Any other documentation as specified in the Purchase Order.

**v) Conditions for transportation:**



- a) All shipping documents shall show the Purchase Order Number & Date, Import Licence Number & Date, and Letter of Credit Number & Date.
- b) Transshipment is to be avoided.
- c) Loading on deck is not permitted. The transport document must not contain a provision that goods may be carried on deck.
- d) A transport document which is produced or appearing to have been produced by reprographic, automated or computerized systems or as carbon copy will be accepted as an original document provided that it is marked as original and is ink-signed.
- e) The transport document must contain all the conditions of carriage on the original document.
- f) The transport document must not indicate the place of destination as being different from the port of discharge.
- g) The transport document must not contain the indication 'intended' or similar qualification in relation to the vessel or other means of transport or port of loading or port of discharge.
- h) The transport document must be issued by the carrier or his agent and not by any freight forwarder.
- i) Transport documents bearing reference by stamp or otherwise, to costs additional to the freight charges are not acceptable.
- j) The Bills of Exchange must be dated and presentation of documents for negotiation must not be later than 15 days after the date of shipment and in any case not later than the expiry date of the Credit.
- l) Indian suppliers shall dispatch the materials on freight prepaid and on door-delivery basis (FOR Destination – Destination: BHEL Stores) and
- m) In the event there is a delay by the Supplier in negotiating / submitting the document, any demurrage / wharfage arising out of the same shall be to the account of the Supplier and shall be deducted from the final payment. Also, in such cases, the Supplier shall authorize the Steamer / Shipping agent / transporter to freely release the consignment to BHEL by providing a “Surrender Bill of Lading”. Over-seas Suppliers have to give a No-Objection Certificate to BHEL, authorizing BHEL to get the Delivery Order from the Steamer Agent without producing the Original Bill of Lading. This is required to ensure avoidance of incidence of demurrage at Chennai Sea-port that may arise in case of delayed presentation of documents by the Seller.

**G) Reverse auction (RA) / on-line bidding on internet:**

*1. “BHEL reserves the right to go for Reverse Auction (RA) (Guidelines as available on [www.bhel.com](http://www.bhel.com)) instead of opening the sealed envelope price bid, submitted by the bidder. This will be decided after techno-commercial evaluation. Bidders shall give their acceptance with their offer for participation in RA. Non-acceptance to participate in RA may result in non-consideration of the bids, in case BHEL decides to go for RA.”*

*2. Those bidders who have given their acceptance to participate in Reverse Auction will have to necessarily submit ‘Process compliance form’ (to the designated service provider) as well as ‘Online sealed bid’ in the Reverse Auction. Non-submission of ‘Process compliance form’ or ‘Online sealed bid’ by the agreed bidder(s) will be considered as tampering of the tender process and will invite action by BHEL as per extant guidelines for “Suspension of Business Dealings with Suppliers/ Contractors (as available on [www.bhel.com](http://www.bhel.com)).”*

3. The philosophy followed for reverse auction shall be English Reverse (No ties).
4. For the proposed reverse auction, technically and commercially acceptable bidders only shall be eligible to participate.
5. BHEL will engage the services of a service provider who will provide all necessary training and assistance before commencement of on line bidding on internet.
6. In case of reverse auction, BHEL will inform the bidders the details of Service Provider to enable them to contact & get trained.
7. Business rules like event date, time, bid decrement, extension etc. also will be communicated through service provider for compliance.
8. Bidders have to fax the Compliance form (annexure IV) before start of Reverse auction. Without this, the bidder will not be eligible to participate in the event.
9. Reverse auction will be conducted on scheduled date & time.

**Note: Decision to go for RA or not will be on case to case basis.**

10. At the end of Reverse Auction event, the lowest bidder value will be known on auction portal.
11. The lowest bidder has to fax/e-mail the duly signed and filled-in prescribed format for price breakup including that of line items, to the Service provider within two working days of Auction without fail.
12. Bidders are be required to read the “Terms and Conditions” section of the auctions site of Service provider, using the Login IDs and passwords given to them by the service provider before reverse auction event. Bidders should acquaint themselves of the „Business Rules of Reverse Auction“, which will be communicated before the Reverse Auction.
13. If the Bidder or any of his representatives are found to be involved in Price manipulation/ cartel formation of any kind, directly or indirectly by communicating with other bidders, action as per extant BHEL guidelines, shall be initiated by BHEL and the results of the RA scrapped/ aborted.
14. The Bidder shall not divulge either his Bids or any other exclusive details of BHEL to any other party.
15. The bidders have to necessarily submit online sealed bid less than or equal to their envelope sealed price bid already submitted to BHEL along with their offer. The envelope sealed price bid of successful L1 bidder in RA, if conducted, would also be opened after the RA and the order will be placed on lower of the two bids (RA closing price & envelope sealed price) thus obtained. It is considered that the bidder having submitted their offer specifically agrees to this condition and undertakes to execute the contract on thus awarded rate/s.
16. If it is found that L1 bidder has quoted higher in the online sealed bid in comparison to the envelope sealed bid for any item(s), the bidder will be issued a warning letter to this effect. However, if the same bidder again defaults on this count in any subsequent tender, it will be considered as fraud and will invite action by BHEL as per extant guidelines for suspension of business dealings with suppliers/ contractors (as available on [www.bhel.com](http://www.bhel.com)).”
17. The calculation sheet e.g. excel sheet (which will help to arrive at ‘Total Cost to BHEL’) will be communicated to respective bidders of RA by BHEL. In line with the NIT terms, BHEL will provide the calculation sheet (e.g., EXCEL sheet) which will help to arrive at “Total Cost to BHEL” like Packing & forwarding charges, Taxes and Duties, Freight charges, Insurance, Goods & Services Tax (GST) and loading

factors (for non-compliance to BHEL standard Commercial terms & conditions) for each of the bidder to enable them to fill-in the price and keep it ready for keying in during the Auction.]

18. This calculation sheet will be finalized based on the evaluation criteria specified in the NIT.

19. Suppliers are required to submit their best price bid in a separate sealed cover along with techno-commercial bid. After evaluation of Techno-Commercial Bids:

a) In case BHEL decides not to conduct RA, the envelope sealed price bids of all techno-commercially qualified bidders, along with price impact, if any, would be opened and processed as per extant the internal Purchase/ Works Policy as applicable to BHEL.

b) In case BHEL decides to conduct RA, business rules of RA will be sent to service provider.(See Annexure for Model General Business Rules of RA.)

20. Generally the start price for the RA would be the lowest of

a) Lowest online sealed bid and

b) Internal Estimate of BHEL

Note: Wherever more than one lowest online sealed bids are identical and lower than the estimate, the start price, would be that price arrived by reducing the lowest online sealed bid by maximum of one decrement.

21. Reverse auction process would deemed to have started upon receipt of 'Online Sealed Bids' from the bidders within the prescribed time frame as per Business Rules.

22. After receipt of 'online sealed bids', the start price & bid decrement will be decided by BHEL and the same would be communicated to the service provider, to start the bidding process.

23. Only those bidders who have submitted the 'online sealed bid' within the scheduled time would be eligible to participate further in RA process. However, the H1 bidder (whose quote is highest in online sealed bid) will not be allowed to participate in further RA process provided minimum three bidders are left after removal of H1 bidder. In case of tie for H1 bid (identical online sealed bids), 15 minutes additional time would be provided and all the participating bidders would be informed by mail/ message on bidding screen to enable bidders submit revised online sealed bids so as to break the tie.

24. If the lowest online sealed bid is the starting price, then the lowest bidder in online sealed bid shall be shown as current L1 automatically by the system. System would have the provision to indicate this bid as current L1 for further bidding.

25. If the start price is lower than the lowest online sealed bid, on acceptance of such start price by any bidder, this bid would be indicated as current L1 for further bidding.

26. In case of no further bidding, RA will be deemed to have been successful with current L1 bidder.

27. All bidders who had given online sealed bid would be able to see their rank and L1 price and their ranking L1, L2 etc. would be based on their last quoted price irrespective of quote received in RA or online sealed bid.

28. RA shall be treated as failed in the following scenarios:

a) In cases where the start price is (a) estimate or (b) one decrement (maximum) lower than the lowest of the online sealed bids and no bidder accepts the start price.

- b) In cases where the number of online sealed bids are less than four before removal of highest bidder.
- c) In cases of tie among H1 bidders, even after extension of submission of online sealed bids once by 15 minutes.
- d) Wherever, the evaluation is done for individual line items, RA shall be treated as failed only for those line item(s) for which any of the above a), b) or c) satisfies.
29. In cases of failure of RA, sealed envelope price bids (of item(s) for which RA has failed) of all the techno-commercially qualified bidders would be opened and the tender would be processed accordingly. However, the envelope sealed bid(s) of techno-commercially acceptable bidder(s) who had agreed to participate in the RA and had failed to submit the online sealed bid would not be opened.
30. After declaring L1 upon completion of RA, the envelope sealed price bid of L1 bidder would also be opened for placement of order on lower of the two bids (RA closing price & envelope sealed price) and the offers would be processed as per extant their internal Purchase/ Works policy provisions of BHEL. Action as per NIT terms would be taken if online sealed bid is higher than the envelope sealed bid.
31. Relative position of bidders (for usage in cases of predefined splitting the quantities) would also include bidders who have given 'online sealed bids' but have not given further bids in auction. In case of splitting requirement, H1 bidder may be considered for counter offer if the pre-stated (NIT) numbers of suppliers do not accept the counter offer. However, principle of splitting to N-1 bidder would be maintained.
32. In case H1 bidder happen to be MSE and was removed from further bidding but is within L1 + 15% band, then this bid would be considered and to be processed in line with 'Public Procurement Policy for Micro & Small Enterprises (MSEs) order, 2012'.
33. For providing preference to domestically manufactured Electronic Products, in accordance with Department of Electronics and Information Technology (DeitY) Gazette Notification No. 33(3)/2013-IPHW dated 23.12.2013 and its related notifications issued from time to time, H1 bidder removed from further bidding would be considered for counter-offer to meet domestic bidder requirement for the item(s) under procurement.
34. In case BHEL decides not to go for Reverse Auction for the tender enquiry, the Price bids and price impacts, if any, already submitted and available with BHEL would be opened as per BHEL's standard practice.
35. In case of enquiry through e-Procurement, the sealed electronic price bid (e-bid) would be treated as sealed envelope price bid.

**Note: In order to bring more transparency and to address any queries of Bidders on Reverse Auction, an abridged version of BHEL's "Common Guidelines for conducting Reverse Auction (RA)" has been hosted in BHEL's web site [www.bhel.com](http://www.bhel.com) under the links "Supplier Registration Page" and "Tender Notification". All Bidders are requested to visit the link and familiarize themselves with BHEL's RA procedures and guidelines before submission of their bid/s. Submission of Bid shall mean that the Bidder has read and understood BHEL's RA procedures and the bid is in agreement with the same.**

## **H] Force Majeure**

If at any time during the currency of this contract, the performance in whole or in part, by either party of any obligations under this contract shall be prevented or delayed by reason, of any war, hostilities, acts of the public enemy, civil commotion, sabotage, fires, explosions, epidemics, quarantine, restrictions or acts of GOD (hereinafter referred to as events), then provided notice of happening of any such events is given by either party to other within ten days from the date of occurrence thereof, neither party shall reason of such events be entitled to terminate this contract nor shall either party have any such non performance and delay is resumed as soon as practicable after such events has come to an end or ceased to exist. If the performance in whole or part of any obligation under this contract is prevented or delayed by reason or any such event claims for extension of time shall be granted for period considered reasonable by the purchaser subject to prompt notification by the seller to the purchaser of the particulars of the events and supply to the purchaser if required of any supporting evidence. Any waiver of time in respect of partial installment shall not be deemed to be a waiver of time in respect of remaining deliveries.

## **I] Cancellation of Order:**

In the event of non-performance of the contract by the Supplier, BHEL reserves the right to cancel the order with issue of a written notice. BHEL would provide a curing period of 30 days, for the Supplier to rectify the situation. If the Supplier fails to rectify the reason/s that led to the issue of cancellation notice by BHEL, then the cancellation order would be issued automatically by BHEL, without further recourse to the Seller. BHEL will not pay any cancellation charges or any other charges / damages to the Supplier, arising out such cancellation. In the event of the non-performance of the supply contract, by the Supplier, the rights of BHEL include, in addition to cancelling the order, to take alternate purchase action at the cost and risk of the supplier. The additional expenditure to be incurred by BHEL in such alternate purchase would be to the account of the supplier. (Risk Purchase). This remedy would be in addition to the invoking of the CEBG on grounds of failure of the Supplier in executing the Contract and any other legal remedies." BHEL reserves the right to initiate the alternate purchase action at the cost and risk of the erring supplier by issue of a simple notice of intention for the alternate purchase action duly sent by any electronic means and / or by a letter. The cancellation of the order would not be a pre-condition for initiation of the alternate purchase action.

## **J] Contract Execution Bank Guarantee:**

To demonstrate the fidelity of the successful bidder, in executing the Contract, on receipt of the Letter of Intent / Purchase Order, the Supplier shall arrange to provide a contract execution bank guarantee (CEBG). The format of the CEBG is a part of this enquiry. The format may be downloaded and necessary stamping may be obtained from the Banker towards submission of the CEBG. The indigenous suppliers have to provide the CEBG from any one of the Nationalized Banks, listed in the annexure to these terms. Overseas suppliers can submit the CEBG from any of the reputed International / National Bankers. However the CEBG is to be confirmed by any of the Bankers listed by us. In the event of failure by the Supplier to execute the contract either fully or partially, BHEL would encash the entire CEBG. The CEBG shall be valid for the period covering the agreed delivery date of the order with a further claim period of 3 months on the last specified delivery date. In the event of the failure of delivery BHEL would proceed with encashing the CEBG without reference to the Supplier. In the event of BHEL granting extension of the delivery dates, then the CEBG validity shall also be got extended by the Supplier to the extent of the extended delivery times together with the claim period as specified elsewhere. **The CEBG shall be for a value of 2% of the Purchase order.**

**Suppliers who are all already registered with BHEL and having a vendor performance rating of A or A+ grade would be exempted from submission of CEBG.**

#### **Performance Bank Guarantee**

Where ever so required, the Supplier shall arrange to provide a Performance bank guarantee (PBG). The indigenous suppliers have to provide the PBG from any one of the Nationalized Banks, listed in the tender terms. Overseas suppliers can submit the PBG from any of the reputed International / National Bankers. However the PBG shall be confirmed by any of the Bankers listed by us. The PBG shall guarantee the performance of the equipment / materials / items supplied and shall cover the guarantee period. The PBG shall have a claim period of 3 months in addition to the guarantee period. In the event of failure of the supplies made within the guarantee period, BHEL would encash the entire PBG. **The PBG shall be for a value of 10% of the Purchase order.**

**The supplier/s have to get the PBG format (pre-printed) from BHEL and get the same stamped by the Banker. Change of PBG terms either by the supplier's Banker or by the supplier, after servicing of the order is not acceptable. Similarly PBG prepared by the supplier (typed by them) will also not be acceptable to BHEL. The pre-printed form issued by BHEL shall be used for making the PBG.**

#### **K] Post-order submission of documents for approval**

In the event of the release of Letter of Intent (LoI) / Purchase order/s (PO) against this tender, Bidders have to submit the applicable documents as called for in the tender / LoI / PO/s, such as drawings, data sheets, design calculations etc. These documents for approval have to be submitted within the agreed timelines between BHEL and Bidder. Normally the time period for submission for approval is 15 days from the date of receipt of the LoI / PO by the supplier. The actual time period within which the documents have to be submitted for approval would be specified in the LoI / PO.

Such documents would be subjected to evaluation and approval by BHEL and / or by BHEL's customer / Consultant / Customer's Consultant. Bidders have to give their specific acceptance for this.

After approval of such documents and after getting clearance from BHEL, only the items ordered can be taken up for manufacture.

Any changes required by BHEL / Customer etc. in the documents submitted for approval shall be incorporated by the Bidder and no extra cost would be payable by BHEL for such changes.

In the event that the Bidder does not carry out the required corrections, then the LoI / PO would be liable for cancellation by BHEL and BHEL would resort to alternate purchase action at the risk and cost of the Bidder under the Risk Purchase Condition of the Purchase Order.

*Note: After receiving the LoI / PO, supplier shall also forward the acknowledgement / acceptance of the LoI / PO by signing and returning the second copy of the LoI / PO as the token of acceptance.*

#### **L] Others**

a) In case of any contradiction in the terms and conditions given here and elsewhere in the other documents of the tender, it shall be the responsibility of the tenderer to get it clarified from BHEL. The officer authorized to provide such clarifications is the tender issuing officer.

b) Alterations to the conditions of the Tender can be done only by the authorized officer, at any time before the date and time of tender opening and would be duly communicated through a corrigendum.

c) **Suspension of Business dealings with Suppliers:**



(i) Before submitting offer, prospective bidders are advised to visit our web-site [www.bhel.com](http://www.bhel.com) / supplier registration to familiarize themselves with BHEL's policy and procedures of Suspension of Business Dealings with Suppliers.

Submission of offer shall be deemed to be evidence of the Bidder to have read and understood the above said policy.

**ii) Treatment of Banned / Under-performing Vendors:**

Any supplier who has been put on "Hold" or "Banned" from having business dealings with BHEL, Ranipet or any other unit of BHEL shall not submit their offer against this tender. If any such offers are received they would be summarily rejected and sent back. During the processing of tender, if any unit of BHEL puts a supplier on "Ban" then further processing of the offer will not be taken up and in case an order is placed, BHEL, Ranipet may resort at their discretion to cancel the PO either fully or partially.

If any of the supplier who is supplying similar material to BHEL, Ranipet has a Vendor Performance Rating (VPR) score of 'C' or below, then offer given by such parties will not be considered for ordering in this tender.

If any of the Bidders have unexecuted order/s with BHEL and if in such orders, the deliveries have been delayed beyond a reasonable period (say 30 days of agreed delivery period), the offer of such Bidders will also be liable for rejection.

Offers of such of those bidders against whom action for suspension of business dealings has been initiated by BHEL, Ranipet or any other Units/Division of BHEL will also not be considered in this tender.

**d) Fraud Prevention Policy:**

The Bidder along with its associate/ collaborators/ sub-contractors/ sub-vendors/ consultants/ service providers shall strictly adhere to BHEL Fraud Prevention Policy displayed on BHEL website <http://www.bhel.com> and shall immediately bring to the notice of BHEL Management about any fraud or suspected fraud as soon as it comes to their notice.

**e) Applicability of Integrity Pact:-**

IP is a tool to ensure that activities and transactions between the Company and its Bidders/ Contractors are handled in a fair, transparent and corruption free manner. A panel of Independent External Monitors (IEMs) have been appointed to oversee implementation of IP in BHEL.

The IP as enclosed with the tender is to be submitted (duly signed by authorized signatory who signs in the offer) along with techno-commercial bid. Only those bidders who have entered into such an IP with BHEL would be competent to participate in the bidding. In other words, entering into this Pact would be a preliminary qualification.

Details of IEM for this tender is furnished below:

Name \_\_\_\_\_  
Address \_\_\_\_\_  
Email \_\_\_\_\_

Please refer Section-8 of IP for Role and Responsibilities of IEMs. In case of any complaint arising out of the tendering process, the matter may be referred to the IEM mentioned in the tender.

Note:

*No routine correspondence shall be addressed to the IEM (phone/ post/ email) regarding the clarifications, time extensions or any other administrative queries, etc on the tender issued. All such clarification/ issues shall be addressed directly to the tender issuing (procurement) department*



*For all clarifications/ issues related to the tender, please contact:*

Name: (1) ..... (2) .....  
Dep't: .....  
Address: .....  
.....  
Phone:(Landline/Mobile) (1) ..... (2) .....  
Email:  
Fax:

Integrity Pact are applicable for all the BHEL enquiries whose estimated value is equal to or more than Rupees 05 Crores.

Copy of Integrity Pact with applicable nominated IEM is attached along with the tender documents for ready reference of Suppliers.

f) If any Supplier attempts to bribe, or pay commission, gift or any advantage or bring in undue influence either by himself or on his behalf any one including a stranger to the tender, in addition to instituting legal proceedings as per the extant laws prevailing, will disqualify the supplier from this tender and all future tenders of BHEL. Decision of the Purchaser would be final in this matter.

g) The laws governing this transaction shall be the laws in India.

h) Wherever not specified, Inco terms 2010 shall be used to interpret the Commercial terms and conditions and

i) In the event of an order, Supplier shall agree to settlement of disputes or differences, if any, by way of arbitration, in accordance with the “Rule of Arbitration” of the Indian Council of Arbitration.

*The language in the tender documents downloaded by the Bidders shall at no point of time be changed, altered or modified in any manner by the Tenderer. If such changes are made by any tenderer, it shall be considered as tampering with BHEL's terms and the offer shall be summarily rejected, whenever it is noticed by BHEL. Such Bidders would be disqualified from the Bidding Process and their offers would be forfeited / Bank Guarantees invoked. They would also not be allowed to participate in future tenders of BHEL.*

**M. Conditions for rejection of offers:**

**Following is the list of situations which would lead to rejection of offer/s.**

**This list is not exhaustive but only indicative.**

BHEL reserve the right to reject one or all offers without assigning any reason. The decision of BHEL will be final in this regard.

- 1. If the offer fails to meet the technical requirements/specifications of the tendered item/s.*
- 2. If the offer does not meet the commercial terms & conditions, such as but not limited to delivery period specified in the tender, Delivery terms, payment terms, Liquidated damages, Risk Purchase, cancellation clause etc., including the load factors specified in the tender.*
- 3. If the bidder fails to respond to clarification sought, within a reasonable period. In case of doubts / lack of clarity on the technical and commercial offer of the bidder, BHEL will seek clarifications. Bidders are required to respond completely to such BHEL's queries within 3 working days unless otherwise agreed to in writing by BHEL for period beyond 3 days. If supplier fails to respond within*



*3 working days or maximum 2 working days on a reminder thereon, the offer of such bidders will be automatically dis-qualified in the tender without further recourse to informing the bidder.*

*4. If any of the conditions listed below are applicable to the bidder, the offer is liable to be rejected:*

If any

- Debt recovery / Winding up Proceedings are initiated against the Company in Courts / Debt Recovery Tribunals (DRTs),
- Proceedings are there against the Company in National Company Law Tribunal (NCLT) with respect to Insolvency and Bankruptcy Code (IBC) or otherwise,
- Any proceedings are there against the Company under the “Securitization and Reconstruction of Financial Assets and Enforcement of Security Interest (SARFAESI) Act,
- Any restructuring proceedings are underway for the Company under Corporate Debt Restructuring (CDR), Strategic Debt Restructuring (SDR) or otherwise,
- Divestment / demerger proceedings are underway for the Company under the Companies Act.

The above list is not exhaustive but is indicative only.

**N. Special Note:**

BHEL is a Government of India Undertaking. Its procurement practices are governed by the (Internal) Purchase Policy issued by the management of the company and as per Annexure B applicable at the time of finalising the order against this tender.

**-O-**

**Record of Revisions:**

| Revision No. | Revision Date | Modification                                                                                                                                                   |
|--------------|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 01           | 17.08.2016    | Payment terms for Foreign suppliers modified wrt loading- Clause k.ii                                                                                          |
| 02           | 29.08.2016    | Treatment of banned vendors – Para 3 added - Clause L.ii                                                                                                       |
| 03           | 14.09.2016    | Opening of offers – clause B – sub clause ‘b’ included and existing clause ‘b’ renamed as ‘c’.                                                                 |
| 04           | 14.09.2016    | Opening of offers – Note – sub clause (ii) modified                                                                                                            |
| 05           | 12.10.2016    | Clause N. Special Note added                                                                                                                                   |
| 06           | 22.10.2016    | Clause G Reverse Auction modified.<br>Annexure on General Business Rules for Reverse Auction appended<br>Role of Principals added under ‘Miscellaneous’        |
| 07           | 20.01.2017    | Clause L (e) is modified.<br>Clause L (f ,g ,h) renumbered.                                                                                                    |
| 08           | 24.02.2017    | Clause F(c) modified.                                                                                                                                          |
| 09           | 08.07.2017    | Clause M, Point 4 is added – regarding the financial health of the Bidder - as a criterion for disqualification.                                               |
| 10           | 20.07.2017    | Duties and Taxes replaced with GST; Applicability of GST for LD inserted in Clause E; Treatment of poor performing current vendors inserted in clause L.c.(ii) |

## ANNEXURE

### Model General Business Rules for Reverse Auction

This has reference to tender no {tender number....date...}. BHEL shall finalise the Rates for the supply of {item name} through Reverse Auction mode. BHEL has made arrangement with M/s. {Service provider}, who shall be BHEL's authorized service provider for the same. Bidders should go through the instructions given below and submit acceptance of the same. The technical & commercial terms are as per (a) BHEL Tender Enq. No. {...} dated {...}, (b) Bidders' technical & commercial bid (in case of two part bid) and (c) subsequent correspondences between BHEL and the bidders, if any.

#### 1. Procedure of Reverse Auctioning

- i. Online Sealed Bid: This duration of online sealed bid will be {...} minutes. All bidders to submit their online sealed bids during this period.
- ii. Online Reverse Auction: The 'opening price' i.e. start price for RA and 'bid decrement' will be decided by BHEL.
- iii. If BHEL decides the lowest online sealed bid as the starting price, then the lowest bidder in online sealed bid shall be shown as current L1 automatically by the system and no acceptance of that price is required. System shall have the provision to indicate this bid as current L1.
- iv. Bidders by offering a minimum bid decrement or the multiples thereof can displace a standing lowest bid and become "L1" and this continues as an iterative process.
- v. After the completion of the online reverse auction, the Closing Price (CP) shall be available for further processing.

**2. Schedule for Reverse Auction:** The Reverse Auction is tentatively scheduled on {date}: and the duration of online sealed bid will be {...} minutes. All bidders to submit their online sealed bids during this period.

#### - Online Sealed Bid:-

- {Start Time:
- Close Time: }

#### - Online Reverse Auction:-

- {Start Time:
- Close Time: }

#### 3. Auction extension time:

If a bidder places a bid in the last {...} minutes of closing of the Reverse Auction and if that bid gets accepted, then the auction's duration shall get extended automatically for another {...} minutes, for the entire auction (i.e. for all the items in the auction), from the time that bid comes in. Please note that the auto-extension will take place only if a bid comes in those last {...} minutes and if that bid gets accepted as the lowest bid. If the bid does not get accepted as the lowest bid, the auto-extension will not take place even if that bid might have come in the last {...} minutes. In case, there is no bid in the last {...} minutes of closing of Reverse Auction, the auction shall get closed automatically without any extension. However, bidders are advised not to wait till the last

minute or last few seconds to enter their bid during the auto-extension period to avoid complications related with internet connectivity, network problems, system crash down, power failure, etc.

The above process will continue till completion of Reverse Auction.

Complaints/ Grievances, if any, regarding denial of service or any related issue should be given in writing thru e-mail/ fax to M/s. {Service provider} with a copy to BHEL within 15 minutes prior to initial closing time of Online Reverse Auction.

**4. Bid price:** The Bidder has to quote the {.....} Price inclusive of Packing & Forwarding charges, all the routine & type tests as per tender scope, ED + cess, CST against C-form, Freight (bidder to provide original Freight paid receipt), insurance charges, etc. including loading (if indicated by BHEL due to deviations in technical/ commercial terms) for the Items specified. Details are as shown in Excel Sheet for calculation of total cost to BHEL(To be specified by Unit as per NIT conditions).

**5. Bidding currency and unit of measurement:**

Bidding will be conducted in *Indian Rupees per Unit* of the material as per the specifications {...}

In case of foreign currency bids, exchange rate (TT selling rate of State Bank of India) as on scheduled date of tender opening (Part-I bid) shall be considered for conversion in Indian Rupees. If the relevant day happens to be a Bank holiday, then the forex rate as on the previous bank (SBI) working day shall be taken.

**6. Validity of bids:** Price shall be valid for {... days} from the date of reverse auction. These shall not be subjected to any change whatsoever.

**7. Lowest bid of a bidder:** In case the bidder submits more than one bid, the lowest bid at the end of Online Reverse Auction will be considered as the bidder's final offer to execute the work.

**8.** Bidders shall be assigned a **Unique User Name & Password** by M/s. {Service provider}. Bidders are advised to change the Password and edit the information in the Registration Page after the receipt of initial Password from M/s. {Service provider} to ensure confidentiality. All bids made from the Login ID given to the bidders will be deemed to have been made by the bidders/ bidders 'company.

**9.** Post auction procedure: BHEL will proceed with the Lowest Bid in the Reverse Auction for further processing.

**10.** Any commercial/ technical loading shall be intimated to bidders prior to RA. The excel sheet provided in this regard shall cover all these aspects. Commercial/ technical loading if any, shall be added by the respective bidder in its price during online sealed bid & Online Reverse Auction. Modalities of loading & de-loading shall be separately intimated to the bidders. The responsibility for correctness of total cost to BHEL shall lie with the bidders.

**11.** Computerized reverse auction shall be conducted by BHEL (through M/s. {Service Provider}), on pre-specified date, while the bidders shall be quoting from their own offices/ place of their choice. Internet connectivity shall have to be ensured by bidders themselves.

During the RA process if a bidder is not able to bid and requests for extension of time by FAX/ email/ phone then time extension of additional 15 minutes will be given by the service provider provided such requests come before 5 minutes of auction closing time. However, only one such request per bidder can be entertained. Despite this extension if bidder fails to upload his prices due to extreme case of failure of Internet connectivity, (due to any reason whatsoever may be) it is the bidders'

responsibility/ decision to send fax communication immediately to M/s. {Service provider}, furnishing the price the bidder wants to bid online with a request to the service provider to upload the faxed price online so that the service provider will upload that price online on behalf of the Bidder. It shall be noted clearly that the concerned bidder communicating this price to service provider has to solely ensure that the fax message is received by the service provider in a readable/ legible form and also the Bidder should simultaneously check up with service provider about the clear receipt of the price faxed. It shall also be clearly understood that the bidder shall be at liberty to send such fax communications of prices to be uploaded by the service provider only within the closure of Bid time and under no circumstance it shall be allowed beyond the closure of Bid time /reverse auction. It shall also be noted that the service provider should be given a reasonable required time by the bidders, to upload such prices online and if such required time is not available at the disposal of the Service provider at the time of receipt of the fax message from the bidders, the service provider will not be uploading the prices and either BHEL or the service provider are not responsible for this unforeseen circumstances. In order to ward-off such contingent situation bidders are requested to make all the necessary arrangements/ alternatives whatever required so that they are able to circumvent such situation and still be able to participate in the reverse auction successfully. Failure of power or loss of connectivity at the premises of bidders during the Reverse auction cannot be the cause for not

participating in the reverse auction. On account of this, the time for the auction cannot be extended and neither BHEL nor M/s. {Service provider} is responsible for such eventualities.

**12. Proxy bids:** Proxy bidding feature is a pro-bidder feature to safeguard the bidder's interest of any internet failure or to avoid last minute rush. The proxy feature allows bidders to place an automated bid in the system directly in an auction and bid without having to enter a new amount each time a competing bidder submits a new offer. The bid amount that a bidder enters is the minimum that the bidder is willing to offer. Here the software bids on behalf of the bidder. This obviates the need for the bidder participating in the bidding process until the proxy bid amount is decrementally reached by other bidders. When proxy bid amount is reached, the bidder (who has submitted the proxy bid) has an option to start participating in the bidding process.

The proxy amount is the minimum amount that the bidder is willing to offer. During the course of bidding, the bidder cannot delete or change the amount of a proxy bid. Bids are submitted in decrements (decreasing bid amounts). The application automates proxy bidding by processing proxy bids automatically, according to the decrement that the auction originator originally established when creating the auction, submitting offers to the next bid decrement each time a competing bidder bids, regardless of the fact whether the competing bids are submitted as proxy or standard bids. However, it may please be noted that if a manual bid and proxy bid are submitted at the same instant manual bid will be recognized as the L1 at that instant. In case of more than one proxy bid, the system shall bid till it crosses the threshold value of 'each lowest proxy bid' and thereafter allow the competition to decide the final L1 price. Proxy bids are fed into the system directly by the respective bidders. As such this information is privy only to the respective bidder(s).

**13.** Bidders are advised to get fully trained and clear all their doubts such as refreshing of screen, quantity being auctioned, tender value being auctioned etc. from M/s. {Service provider}.

**14.** M/s. {Service provider}, shall arrange to demonstrate/ train the bidder or bidder's nominated person(s), without any cost to bidders. M/s. {Service provider}, shall also explain the bidders, all the business rules related to the Reverse Auction. Bidders are required to submit their acceptance to the terms/ conditions/modalities before participating in the Reverse Auction in the process compliance form as enclosed. Without this, the bidder will not be eligible to participate in the event.

**15.** Successful bidder shall be required to submit the final prices (L1) in prescribed format (Annexure-VI) for price breakup including that of line items, if required, quoted during the Online Reverse Auction, duly signed and stamped as token of acceptance without any new condition (other than those already agreed to before start of auction), after the completion of auction to M/s. {Service provider} besides BHEL within two working days of Auction without fail.

**16.** Any variation between the final bid value and that in the confirmatory signed price breakup Document will be considered as tampering the tender process and will invite action by BHEL as per extant guidelines for suspension of business dealings (as available on [www.bhel.com](http://www.bhel.com)).

**17.** Bidders' bid will be taken as an offer to execute the work/ supplies of the item as per enquiry No. {...} dt. {...}. Bids once made by the bidder, cannot be cancelled/ withdrawn and bidder shall be bound to execute the work as mentioned above at bidder's final bid price. Should bidder back out and not execute the contract as per the rates quoted, BHEL shall take action as per extant guidelines for suspension of business dealings (as available on [www.bhel.com](http://www.bhel.com)).

**18.** Bidders shall be able to view the following on their screen along with the necessary fields during Online Reverse Auction:

- a. Leading (Running Lowest) Bid in the Auction (only total price of package).
- b. Bid Placed by the bidder.
- c. Start Price.
- d. Decrement value.
- e. Rank of their own bid during bidding as well as at the close of auction

**19.** BHEL's decision on award of contract shall be final and binding on all the Bidders.



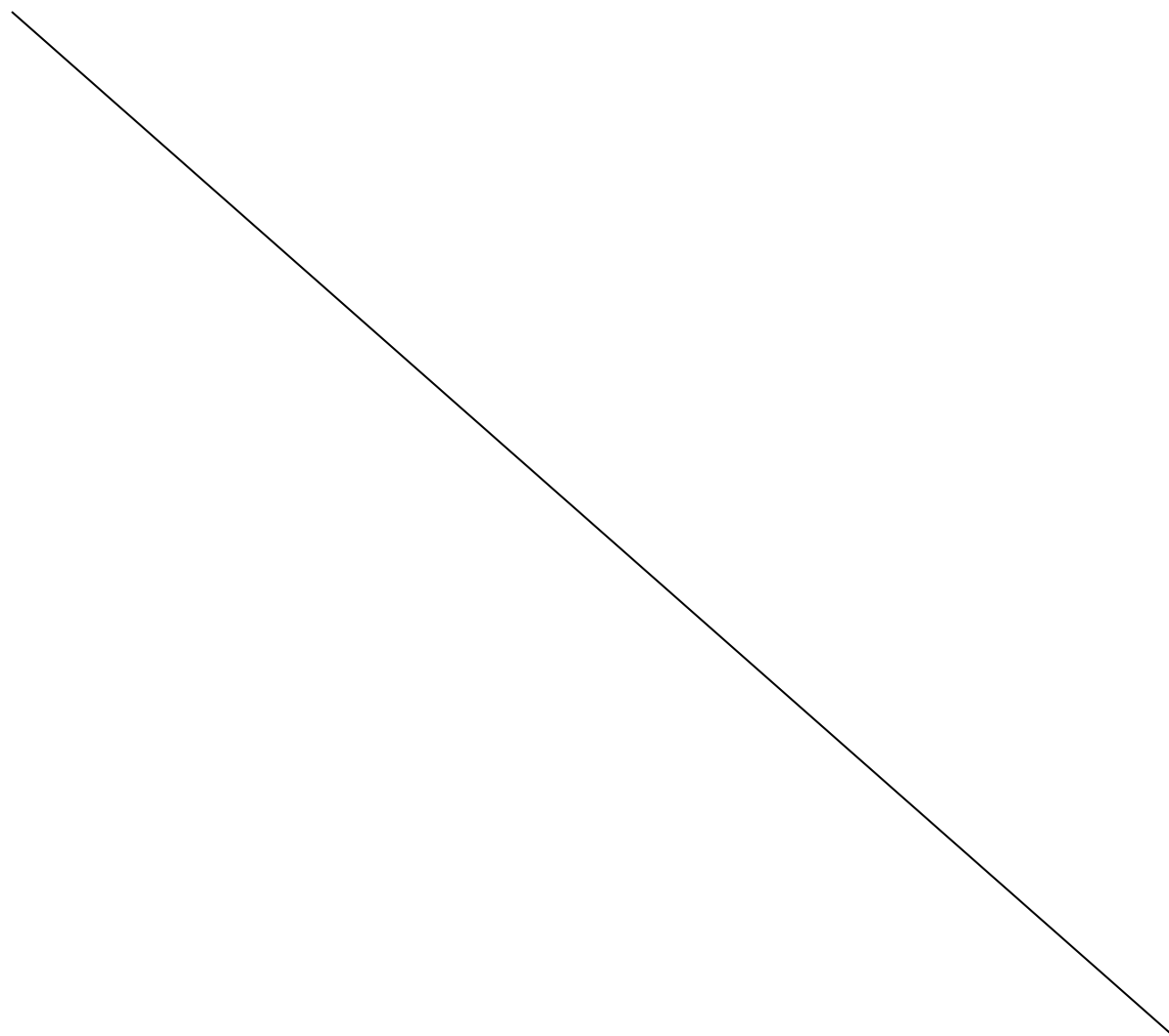
20. BHEL reserves the right to extend, reschedule or cancel the Reverse Auction process at any time, before ordering, without assigning any reason, with intimation to bidders.

21. BHEL shall not have any liability to bidders for any interruption or delay in access to the site irrespective of the cause. In such cases, the decision of BHEL shall be binding on the bidders.

22. Other terms and conditions shall be as per bidder's techno-commercial offers and other correspondences, if any, till date.

23. If there is any clash between this business document and the FAQ available, if any, in the website of M/s. {Service provider}, the terms & conditions given in this business document will supersede the information contained in the FAQs. Any changes made by BHEL/ service provider (due to unforeseen contingencies) after the first posting shall be deemed to have been accepted if the bidder continues to access the portal after that time..

24. Bidder shall not divulge either his Bids or any other exclusive details of BHEL to any other party. If the Bidder or any of his representatives are found to be involved in Price manipulation/ cartel formation of any kind, directly or indirectly by communicating with other bidders, action as per extant BHEL guidelines for suspension of business dealings (as available on [www.bhel.com](http://www.bhel.com)), shall be initiated by BHEL.





**RA price confirmation and breakup**  
(To be submitted by L1 bidder after completion of RA)

To  
- M/s. Service provider  
- Postal address

CC: M/s BHEL

BOILER AUXILIARIES PLANT  
INDIRA GANDHI INDUSTRIAL COMPLEX  
RANIPET – 632406  
TAMILNADU  
INDIA.

Sub: Final price quoted during Reverse Auction and price breakup

Dear Sir,

We confirm that we have quoted.

**Rs.{ \_\_\_\_\_ in value & in words \_\_\_\_\_ } for item(s) covered under tender enquiry**  
**No. {...} dt.{...}**

Total price of the items covered under above cited enquiries is inclusive of {Packing & forwarding, E.D. , C.S.T. , freight and insurance charges up to {.....}  
District, {.....} State and Type Test Charges etc., [exclusive of Goods & Services tax (GST)],  
other as  
per NIT}

as our final landed prices as quoted during the Reverse Auction conducted today {date} which will  
be valid for a period of { \_\_\_\_ in nos. & in words \_\_\_\_ } days.

The price break-up including that of line items is as given below.

Total

=====  
- Rs.in value & in words  
=====

Thanking you and looking forward to the valuable order from BHEL.

Yours sincerely,  
For \_\_\_\_\_  
Name:  
Company:  
Date:  
Seal:

| <p align="center"> <b>BHEL : BAP : RANIPET</b><br/> <b>PURCHASE - DESALINATION</b><br/> <b>ANNEXURE - C</b><br/> <b>DESIGN, MANUFACTURING, TESTING &amp; SUPPLY OF</b><br/> <b>RO SYSTEM FOR PWTS &amp; ETP INCLUDING ALL ACCESSORIES</b><br/> <b>FOR KECL TANZANIA 371.2MW CCP PROJECT</b><br/> <b>(INTERNATIONAL ORDER)</b><br/> <b>Enquiry No. 7770668E DATED 19-JUL--2017 Due Date 17-AUG-2017 (NIT_33778)</b> </p> |                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                              |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| Sl. No.                                                                                                                                                                                                                                                                                                                                                                                                                 | DESCRIPTION                                                                                                        | BHEL (PURCHASER) REQUIREMENT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | VENDOR (SELLER) CONFIRMATION |
| <b>I</b>                                                                                                                                                                                                                                                                                                                                                                                                                | <b><u>Technical</u></b>                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                              |
| 01                                                                                                                                                                                                                                                                                                                                                                                                                      | SCOPE OF SUPPLY                                                                                                    | <p>Please confirm the Scope of Supply of <b>"RO SYSTEM FOR PWTS &amp; ETP INCLUDING ALL ACCESSORIES "</b> as per Specification No.</p> <p>01. ROS:6169 REV 00 DATED 27.06.2017 - TECHNICAL SPECIFICATION FOR PTWS,</p> <p>02. ROS:6170 REV 00 DATED 27.06.2017 - TECHNICAL SPECIFICATION FOR ETP</p> <p>03. ROS:4172 REV 00 DATED 23.06.2017 - E, C &amp; I</p> <p>04. P &amp; ID FOR RO - PWTS 1 WT 150 01043 REV 00</p> <p>05. P &amp; ID FOR RO - ETP 1-WT-060-01044 REV 00</p> <p>06. P &amp; ID BOQ FOR PWTS - ANNEXURE - A</p> <p>07. P &amp; ID BOQ FOR ETP - ANNEXURE - A</p> <p>08. VENDOR LIST 280617,</p> <p>09. SEAWORTHY PACKING SPECIFICATION PE TS 888 100 A001 REV 00,</p> <p>10. QUALIFICATION REQUIREMENT RO SYSTEM ANNEXURE III,</p> <p>11. MANDATORY SPARES ANNEXURE II.</p> <p>submit the same after necessary Filling,signing &amp; returning a copy of the same.</p> |                              |
| 02                                                                                                                                                                                                                                                                                                                                                                                                                      | SPECIFICATION                                                                                                      | Please confirm Clause wise / Point wise "IN TOTO" for all specifications and submit along with offer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                              |
| 03                                                                                                                                                                                                                                                                                                                                                                                                                      | DATA SHEETS / DRAWINGS                                                                                             | Filled Data Sheets and Drawings are to be submitted along with offer. ( if applicable )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                              |
| 04                                                                                                                                                                                                                                                                                                                                                                                                                      | QUALITY ASSURANCE PLAN (QAP)                                                                                       | To confirm applicable QAP will be followed. (OR) Supplier's Quality Plan to be submitted for our review and approval within 30 days from the date of Letter of Award (LOA).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                              |
| 05                                                                                                                                                                                                                                                                                                                                                                                                                      | SPECIFICATION DEVIATION DISPOSITION REPORT (SDDR)                                                                  | Attached SDDR to be filled & submit along with offer. (Even, If NO deviation is taken, NIL report to be submitted).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                              |
| 06                                                                                                                                                                                                                                                                                                                                                                                                                      | TECHNICAL ADVISORY SERVICES FOR ERECTION STAGE CLEARANCE, COMMISSIONING, POST COMMISSIONING/PG TEST AT KILWA SITE, | <p>Please confirm the carrying out <b>"TECHNICAL ADVISORY SERVICES FOR ERECTION STAGE CLEARANCE, COMMISSIONING, POST COMMISSIONING/PG TEST AT KILWA SITE, " of RO SYSTEM FOR PWTS &amp; ETP INCLUDING ALL ACCESSORIES</b> as per TECHNICAL SPECIFICATION</p> <p>ROS:6169 REV 00 DATED 27.06.2017,</p> <p>ROS:6170 REV 00 DATED 27.06.2017 &amp;</p> <p>ROS:4172 REV 00 DATED 23.06.2017.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                              |
| 07                                                                                                                                                                                                                                                                                                                                                                                                                      | COMMISSIONING SPARES & MANDATORY SPARES                                                                            | <p>The commissioning spares &amp; Mandatory Spares List and the individual price should be indicated.</p> <p>The Bidder should also indicate if any spare(s) other than those indicated in the spec is/are required for trouble free commissioning without additional cost if any, since the Supervision of E&amp;C is the supplier's scope.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                              |
| <b>II</b>                                                                                                                                                                                                                                                                                                                                                                                                               | <b><u>Commercial Terms &amp; Conditions</u></b>                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                              |
| 01                                                                                                                                                                                                                                                                                                                                                                                                                      | PRICE                                                                                                              | Please confirm 'Firm Price' till completion of order                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                              |
| 02                                                                                                                                                                                                                                                                                                                                                                                                                      | UNPRICED BID (PART-1)                                                                                              | <p>Please confirm submission of 'Unpriced bid' in the price bid format attached duly signed.</p> <p>SCANNED COPY of FILLED &amp; SIGNED COPY OF 'Price Bid' format attached by filling all informations by writing 'Quoted' as the case may be in the 'Rate' and 'Value' columns to be submitted through E-Procurement System.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                              |
| 03                                                                                                                                                                                                                                                                                                                                                                                                                      | PRICED BID (PART-2)                                                                                                | <p>Please confirm submission of 'Priced bid' in the price bid format attached duly signed.</p> <p>SCANNED COPY of FILLED &amp; SIGNED COPY OF 'Price Bid' format attached by filling all informations by writing the value as the case may be in the 'Rate' and 'Value' columns in a separate attachment to be submitted through E-Procurement System.</p> <p><b>Price bid opening will be considered after the Techno-Commercial evaluation &amp; further final approval from the customer: M/s. KECL TANZANIA 371.2MW CPP PROJECT</b></p>                                                                                                                                                                                                                                                                                                                                                 |                              |
| 04                                                                                                                                                                                                                                                                                                                                                                                                                      | DELIVERY TERMS & PRICE BASIS                                                                                       | <p>Please confirm for FOR - Destination (<b>BHEL - RANIPET STORES</b>) basis.</p> <p>Unloading the Material at site is BHEL Scope.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                              |



| <p style="text-align: center;"><b>BHEL : BAP : RANIPET</b><br/> <b>PURCHASE - DESALINATION</b><br/> <b>ANNEXURE - C</b><br/> <b>DESIGN, MANUFACTURING, TESTING &amp; SUPPLY OF</b><br/> <b>RO SYSTEM FOR PWTS &amp; ETP INCLUDING ALL ACCESSORIES</b><br/> <b>FOR KECL TANZANIA 371.2MW CCP PROJECT</b><br/> <b>(INTERNATIONAL ORDER)</b><br/> <b>Enquiry No. 7770668E DATED 19-JUL--2017 Due Date 17-AUG-2017 (NIT_33778)</b></p> |                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                              |
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| Sl. No.                                                                                                                                                                                                                                                                                                                                                                                                                            | DESCRIPTION                                                      | BHEL (PURCHASER) REQUIREMENT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | VENDOR (SELLER) CONFIRMATION |
| 05                                                                                                                                                                                                                                                                                                                                                                                                                                 | CONSIGNEE ADDRESS<br>(Detailed TIN No etc., will be given later) | Please confirm supply to the following consignee address in the event of Order.<br><br><b>THE SDGM / STORES/M.S.</b><br><b>BHEL- BAP, RANIPET,</b><br><b>VELLORE DISTRICT- 632 406</b><br><b>TAMILNADU.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                              |
| 06                                                                                                                                                                                                                                                                                                                                                                                                                                 | ORIGIN OF DESPATCH OF VARIOUS CONSIGNMENT                        | Please indicate clearly the origin of despatch of various consignments duly indicating whether interstate or intrastate based on the consignee address above. Origin of despatch should not be subjected to change during execution of contract.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                              |
| 07                                                                                                                                                                                                                                                                                                                                                                                                                                 | PACKING & FORWARDING                                             | Please confirm inclusion of Packing & Forwarding Charges in the Basic quoted price.<br><br>If it is extra payable by BHEL, Please clearly indicate the applicable Packing & Forwarding charges in Lumpsum or % value.<br><br>Packing should be as per <b>"SEAWORTHY PACKING SPEC. PE TS 888 100 A001 REV 00"</b> - Please confirm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                              |
| 08                                                                                                                                                                                                                                                                                                                                                                                                                                 | FREIGHT & INSURANCE                                              | Please confirm inclusion of Freight & Insurance Charges towards this in the Basic quoted price.<br><br>If it is extra payable by BHEL, Please clearly indicate the applicable Freight & Insurance charges in Lumpsum or % value.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                              |
| 09A                                                                                                                                                                                                                                                                                                                                                                                                                                | GOODS AND SERVICES TAX (GST) FOR SUPPLY PORTION                  | Please indicate the exact percentage applicable as on the date of submission of offer and also indicate whether the same is payable extra by BHEL or not.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                              |
| 10                                                                                                                                                                                                                                                                                                                                                                                                                                 | GOODS AND SERVICES TAX (GST) FOR SUPPLY PORTION                  | Please indicate the exact percentage applicable as on the date of submission of offer and also indicate whether the same is payable extra by BHEL or not.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                              |
| 11                                                                                                                                                                                                                                                                                                                                                                                                                                 | PACKING & FORWARDING                                             | Please confirm inclusion of Packing & Forwarding Charges in the Basic quoted price.<br><br>If it is extra payable by BHEL, Please clearly indicate the applicable Packing & Forwarding charges in Lumpsum or % value.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                              |
| 12                                                                                                                                                                                                                                                                                                                                                                                                                                 | PAYMENT TERM FOR SUPPLY.                                         | 1. Eighty Five percent (85%) of basic price of materials supplied, as per approved billing schedule, along with 100% taxes and duties (as applicable), shall be paid against <u>receipt of material at site</u> and submission of Bank Guarantee for 10% of PO value valid till guarantee period towards performance before first submission of documents for payment.<br><br><b>Validity of the Bank Guarantee shall be for the entire Guarantee period. Initially, it should be at least 18 months, later extended to cover the entire guarantee period, two months before its expiry.</b>                                                                                                                                                                                                                                                       |                              |
|                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                  | 2. Five percent (5%) of basic price of materials supplied will be released after submission of Material Receipt Certificate (MRC) from project site engineer of Owner/ Purchaser.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                              |
|                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                  | 3. Balance Ten percent (10%) of supply value after successful completion of Erection, commissioning, PG Test & Handing Over.<br><br>PG Test to be conducted within 120 days from the date of Intimation by VENDOR after successful completion of TECHNICAL ADVISORY SERVICES FOR ERECTION STAGE CLEARANCE, COMMISSIONING, POST COMMISSIONING by VENDOR. If the PG Test is delayed beyond 120 days from the date of commissioning then VENDOR Can submit their invoice for Payment. Validity of the Bank Guarantee shall be for the entire Guarantee period. Initially, it should be at least 18 months plus 3 months claim period. However VENDOR to extend the BG periodically till completion of PG Test.<br><br>Please confirm above payment term and Please note that the Invoices should be submitted strictly on the above Indicated % only. |                              |

| <p align="center"><b>BHEL : BAP : RANIPET</b><br/> <b>PURCHASE - DESALINATION</b><br/> <b>ANNEXURE - C</b><br/> <b>DESIGN, MANUFACTURING, TESTING &amp; SUPPLY OF</b><br/> <b>RO SYSTEM FOR PWTS &amp; ETP INCLUDING ALL ACCESSORIES</b><br/> <b>FOR KECL TANZANIA 371.2MW CCP PROJECT</b><br/> <b>(INTERNATIONAL ORDER)</b><br/> <b>Enquiry No. 7770668E DATED 19-JUL--2017 Due Date 17-AUG-2017 (NIT_33778)</b></p> |                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                              |
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| Sl. No.                                                                                                                                                                                                                                                                                                                                                                                                               | DESCRIPTION                                                                                                                         | BHEL (PURCHASER) REQUIREMENT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | VENDOR (SELLER) CONFIRMATION |
| 13                                                                                                                                                                                                                                                                                                                                                                                                                    | PAYMENT TERM FOR TECHNICAL ADVISORY SERVICES FOR ERECTION STAGE CLEARANCE, COMMISSIONING, POST COMMISSIONING/PG TEST AT KILWA SITE, | <p>90% payment with 100% Duties &amp; Taxes within 45 days after completion of TECHNICAL ADVISORY SERVICES FOR ERECTION STAGE CLEARANCE, COMMISSIONING, POST COMMISSIONING work certified by BHEL Site Engineer.</p> <p>Balance 10% after completion of PG TEST AT KILWA SITE and submission of BG for 10% of Order Value valid till gaurantee period towards performance.</p> <p>PG Test to be conducted within 120 days from the date of Intimation by VENDOR after successful completion of TECHNICAL ADVISORY SERVICES FOR ERECTION STAGE CLEARANCE, COMMISSIONING, POST COMMISSIONING by VENDOR. If the PG Test is delayed beyond 120 days from the date of commissioning then VENDOR Can submit their invoice for Payment. Validity of the Bank Guarantee shall be for the entire Guarantee period. Initially, it should be at least 18 months plus 3 months claim period. However VENDOR to extend the BG periodically till completion of PG Test.</p> <p>Please confirm above payment term and Please note that the Invoices should be submitted strictly on the above Indicated % only.</p> |                              |
| 14                                                                                                                                                                                                                                                                                                                                                                                                                    | CONFIRM THE PAYMENT TERM FOR SUPPLY & SERVICE                                                                                       | <p>Differential Payments applicable for SUPPLY, SERVICE and Others - Within 45 days for MSME &amp; 90 days for Non MSME</p> <p>Please confirm your status in case of MSME with relevant proof.</p> <p><b>For MSME Registration, you have to submit the Notarized copy of MSME certificate with Original CA certificate</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                              |
| 15                                                                                                                                                                                                                                                                                                                                                                                                                    | CONDITION FOR TECHNICAL ADVISORY SERVICE CHARGES                                                                                    | Total TECHNICAL ADVISORY SERVICE charges including GST should be minimum 10% of the total quoted package price (including all taxes and freight), failing which the break-up of prices shall be adjusted accordingly for ordering.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                              |
| 16                                                                                                                                                                                                                                                                                                                                                                                                                    | DELIVERY PERIOD FOR THE SUPPLY                                                                                                      | <p>Please confirm the supply completion on or before <b>30.01.2018 or 5 Months</b> from the date of Manufacturing clearance, which ever is Later.</p> <p>Vendor to submit all drawings/documents within 2 weeks from the date of purchase order and resubmit the drawings/documents within 1 week incorporating all the comments.</p> <p>In case there are delays of submission of drawings/documents beyond 2 weeks of order or 1 week of comments, that much days of delay would be reduced from delivery period.</p> <p>Vendor can also quote improved delivery date if any or otherwise, please clearly indicate the delivery period in weeks / months from the date of Manufacturing clearance.</p> <p>NOTE: Delivery period shall be reckoned till receipt of materials at site. For LD Purpose, Date of site receipt of material will only be considered.</p>                                                                                                                                                                                                                                 |                              |
| 17                                                                                                                                                                                                                                                                                                                                                                                                                    | TECHNICAL ADVISORY SERVICES FOR ERECTION STAGE CLEARANCE, COMMISSIONING, POST COMMISSIONING/PG TEST PERIOD                          | Please confirm the completion of TECHNICAL ADVISORY SERVICES FOR ERECTION STAGE CLEARANCE, COMMISSIONING, POST COMMISSIONING/PG TEST SERVICE PERIOD maximum of fifteen days 3 Visits (comprising three visits & excluding travels and holidays) on BHEL-Ranipet Request basis after receipt of material at Site.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                              |
| 18A                                                                                                                                                                                                                                                                                                                                                                                                                   | LIQUIDATED DAMAGES (LD) - Supply Portion                                                                                            | Please confirm LD for delayed delivery of Equipment (as per IMPORTANT NOTE) @ 0.5% per week for the undelivered portion of the order value and maximum of 10% of the total contract value.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                              |
| 18B                                                                                                                                                                                                                                                                                                                                                                                                                   | LIQUIDATED DAMAGES (LD) - SERVICE Portion                                                                                           | Please confirm LD for delayed ERECTION, COMMISSIONING & PG TEST of Equipment @ 0.5% per week and maximum of 10% of the total contract value.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                              |
| 19                                                                                                                                                                                                                                                                                                                                                                                                                    | OFFER VALIDITY                                                                                                                      | Please confirm Offer Validity for a minimum period of 60 days from the date of price bid opening.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                              |
| 20                                                                                                                                                                                                                                                                                                                                                                                                                    | INSPECTION                                                                                                                          | Please confirm for Inspection of all the Items by BHEL Engineers / BHEL Authorized Engineer and Customer / Consultant Engineer either jointly or individually before the dispatch of the item at vendor works as per approved QAP. Please note that no payment will be made by BHEL towards inspection.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                              |

| <p align="center"><b>BHEL : BAP : RANIPET</b><br/> <b>PURCHASE - DESALINATION</b><br/> <b>ANNEXURE - C</b><br/> <b>DESIGN, MANUFACTURING, TESTING &amp; SUPPLY OF</b><br/> <b>RO SYSTEM FOR PWTS &amp; ETP INCLUDING ALL ACCESSORIES</b><br/> <b>FOR KECL TANZANIA 371.2MW CCP PROJECT</b><br/> <b>(INTERNATIONAL ORDER)</b><br/> <b>Enquiry No. 7770668E DATED 19-JUL--2017 Due Date 17-AUG-2017 (NIT_33778)</b></p> |                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                              |
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| Sl. No.                                                                                                                                                                                                                                                                                                                                                                                                               | DESCRIPTION                                                                                                                                                                                   | BHEL (PURCHASER) REQUIREMENT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | VENDOR (SELLER) CONFIRMATION |
| 21                                                                                                                                                                                                                                                                                                                                                                                                                    | TEST CERTIFICATE (TC)                                                                                                                                                                         | Please confirm that required TC will be provided at 'No Extra Cost'.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                              |
| 22A                                                                                                                                                                                                                                                                                                                                                                                                                   | GUARANTEE CERTIFICATE (GC) - Supply Portion.                                                                                                                                                  | Please confirm furnishing of Guarantee certificate in BHEL format for 12 months from the date of commissioning or 18 months from the date of last despatch whichever is earlier.                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                              |
| 22B                                                                                                                                                                                                                                                                                                                                                                                                                   | GUARANTEE CERTIFICATE (GC) - E & C Portion                                                                                                                                                    | Please confirm furnishing of Guarantee certificate in BHEL format for the system for "12 MONTHS FROM THE DATE OF PG TEST OR 18 MONTHS FROM THE DATE OF COMPLETION OF E&C"                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                              |
| 23                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>Contract Execution Bank Guarantee (CEBG).</b><br>Please Ref: ANNEXURE – B GENERAL TERMS & CONDITIONS (FOR GUIDANCE TO THE SUPPLIERS)Under Clause -JJ<br>Contract Execution Bank Guarantee: | To demonstrate the fidelity of the successful bidder, in executing the Contract, on receipt of the Letter of Intent / Purchase Order, the Supplier shall arrange to provide a contract execution bank guarantee (CEBG).                                                                                                                                                                                                                                                                                                                                                                                                                    |                              |
| 24A                                                                                                                                                                                                                                                                                                                                                                                                                   | BANK GUARANTEE (BG) TOWARDS Supply Portion (10% OF ORDER VALUE)                                                                                                                               | BG to be submitted in the format issued by BHEL.<br>BG for 10% of the Total PO Value. Validity of the Bank Guarantee shall be for the entire Guarantee period. Initially, it should be at least 18 months plus 3 months claim period., later extended to cover the entire guarantee period, three months before its expiry.<br><br>vendor shall submit Contract Performance Bank Guarantee for 10% of Order/ Contract value (excluding taxes, duties & freight) before first submission of documents for payment to cover the due performance of Order/ Contract and to fulfill the guarantee conditions stipulated in the Order/Contract. |                              |
| 24B                                                                                                                                                                                                                                                                                                                                                                                                                   | BANK GUARANTEE (BG) TOWARDS TECHNICAL ADVISORY SERVICES. (10% OF ORDER VALUE)                                                                                                                 | BG to be submitted in the format issued by BHEL.<br>BG for 10% of the Total PO Value valid for 12 months from the date of PG TEST plus 3 months claim period. OR BG to be submitted as per payment term clause no.II-13 and in the format issued by BHEL.                                                                                                                                                                                                                                                                                                                                                                                  |                              |
| 25                                                                                                                                                                                                                                                                                                                                                                                                                    | ERECTION MANUAL (INSTALLATION INSTRUCTIONS)                                                                                                                                                   | Please confirm for providing of 'comprehensive Erection Manual covering the entire supply which include bought-outs' 6 sets in Hard copy & one CD form.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                              |
| 26                                                                                                                                                                                                                                                                                                                                                                                                                    | O & M MANUAL                                                                                                                                                                                  | Please confirm for providing of 'comprehensive O&M Manual covering the entire System' 6 sets in Hard copy & one CD form.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                              |
| 27                                                                                                                                                                                                                                                                                                                                                                                                                    | REVERSE AUCTION                                                                                                                                                                               | Please see the Clause in the main enquiry regarding Reverse Auction (RA). RA will be conducted through our Service Provider. Vendor to confirm acceptance.<br><br>Please note that in case BHEL decides not to conduct RA, the sealed price bids along with the impact price bids arising out of techno-commercial discussions already available with BHEL only will be opened. Please note that no impact price due to non-conductance of RA will be accepted. Vendor to confirm acceptance.                                                                                                                                              |                              |
| 28                                                                                                                                                                                                                                                                                                                                                                                                                    | RISK PURCHASE CLAUSE (CLAUSE No. 6 of General Terms and Conditions for Indigenous offer)                                                                                                      | BHEL's Standard Risk Purchase clause will be applicable. Please confirm.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                              |
| 29                                                                                                                                                                                                                                                                                                                                                                                                                    | ZERO DATE (CONTRACT EFFECTIVE DATE)                                                                                                                                                           | Contract Effective starts from Manufacturing Clearance subject to Documents submission clause.<br>Please confirm for 'Date of Manufacturing Clearance'.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                              |
| 30                                                                                                                                                                                                                                                                                                                                                                                                                    | Loading Criteria                                                                                                                                                                              | Please note that no Commercial deviation is acceptable to BHEL. In case any deviation is taken in any of the commercial terms such as PAYMENT TERMS, LD, PBG, etc., where in we have specified the days, percentages etc., then loading will be done to the extent of the short fall with respect to the upper Limit specified for evaluation.<br><br>In respect of LD offers which do not accept for LD Clause would be summerly rejected - Please Confirm.                                                                                                                                                                               |                              |
| 31                                                                                                                                                                                                                                                                                                                                                                                                                    | NEGOTIATION                                                                                                                                                                                   | In the event of negotiation if any, please confirm participation only by supplier's representative and not by their Agent which include indian Agent in the case of Foreign Offer.                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                              |
| 32                                                                                                                                                                                                                                                                                                                                                                                                                    | OTHER DOCUMENTS FOR APPROVAL (BBU)                                                                                                                                                            | In the event of order vendor should confirm the submission of BBU for the complete system supply with break up for each line item as well as quantities with value.                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                              |

| <p align="center"> <b>BHEL : BAP : RANIPET</b><br/> <b>PURCHASE - DESALINATION</b><br/> <b>ANNEXURE - C</b><br/> <b>DESIGN, MANUFACTURING, TESTING &amp; SUPPLY OF</b><br/> <b>RO SYSTEM FOR PWTS &amp; ETP INCLUDING ALL ACCESSORIES</b><br/> <b>FOR KECL TANZANIA 371.2MW CCP PROJECT</b><br/> <b>(INTERNATIONAL ORDER)</b><br/> <b>Enquiry No. 7770668E DATED 19-JUL--2017 Due Date 17-AUG-2017 (NIT_33778)</b> </p> |                                                                                                                                                                                                                           |                                                                           |                              |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|------------------------------|
| Sl. No.                                                                                                                                                                                                                                                                                                                                                                                                                 | DESCRIPTION                                                                                                                                                                                                               | BHEL (PURCHASER) REQUIREMENT                                              | VENDOR (SELLER) CONFIRMATION |
| 33                                                                                                                                                                                                                                                                                                                                                                                                                      | PLEASE PROVIDE THE STATUTORY DETAILS<br>(Submit a copy of PAN, if not submitted already)                                                                                                                                  | GST Regn. Number                                                          |                              |
|                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                           | Application Reference Number (ARN)                                        |                              |
|                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                           | HSN NO.: HARMONIZED SYSTEM OF NOMENCLATURE UNDER GST FOR THE OFFERED ITEM |                              |
|                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                           | TIN :                                                                     |                              |
|                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                           | PAN No. :                                                                 |                              |
| 34                                                                                                                                                                                                                                                                                                                                                                                                                      | CONTACT PERSON'S ON <b>TECHNICAL DETAILS</b> FOR CORRESPONDENCE                                                                                                                                                           | Name:                                                                     |                              |
|                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                           | Designation:                                                              |                              |
|                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                           | Phone No.:                                                                |                              |
|                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                           | Mobile No.:                                                               |                              |
|                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                           | Fax No.:                                                                  |                              |
|                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                           | E-mail ID:                                                                |                              |
| 35                                                                                                                                                                                                                                                                                                                                                                                                                      | CONTACT PERSON'S ON <b>COMMERCIAL DETAILS</b> FOR CORRESPONDENCE                                                                                                                                                          | Name:                                                                     |                              |
|                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                           | Designation:                                                              |                              |
|                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                           | Phone No.:                                                                |                              |
|                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                           | Mobile No.:                                                               |                              |
|                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                           | Fax No.:                                                                  |                              |
|                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                           | E-mail ID:                                                                |                              |
| 36                                                                                                                                                                                                                                                                                                                                                                                                                      | <p><b>BHEL will not take cognizance of commercial terms mentioned by the bidder any where else.</b></p> <p><b>Commercial terms and conditions indicated in this Annexure - A will only be applicable and binding.</b></p> | Acceptance Required                                                       |                              |
| <p align="right">Signature, Seal &amp; Date of offerer on all the pages.</p>                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                           |                                                                           |                              |

**ANNEXURE - D**  
**BHEL : BAP : RANIPET**  
**PURCHASE - DESALINATION**  
**PRICE OFFER FORMAT**  
**DESIGN, MANUFACTURING, TESTING & SUPPLY OF**  
**RO SYSTEM FOR PTWS & ETP INCLUDING ALL ACCESSORIES**  
**FOR KECL TANZANIA 371.2MW CCP PROJECT**  
**(INTERNATIONAL ORDER)**  
**Enquiry No. 7770668E DATED 19-JUL--2017 Due Date 17-AUG-2017 (NIT\_33778)**

**PRICE OFFER - SUPPLY**

| Enquiry<br>Sl.<br>No. | Description                                                                                                                                                                                                                                                       | Unit | Qty. | Rate / Unit<br>in Rs. | Amount in<br>Rs. |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|-----------------------|------------------|
| 001                   | RWT705160001<br>CARTRIDGE FILTERS FOR RO STAGE-1 WITH<br>ELEMENTS AIR VENT, DRAIN VALVE & ETC., AS<br>PER TECHNICAL SPECIFICATION NO. ROS:6169<br>REV 00 DATED 27.06.2017 &<br>ROS:4172 REV 00 DATED 23.06.2017                                                   | ST   | 3.00 |                       |                  |
| 002                   | RWT705160002<br>RO STAGE-1 HIGH PRESSURE PUMP WITH VFD<br>MOTOR ASSEMBLY.& ACCESSORIES,<br>AS PER TECHNICAL SPECIFICATION NO.<br>ROS:6169 REV 00 DATED 27.06.2017 &<br>ROS:4172 REV 00 DATED 23.06.2017                                                           | ST   | 3.00 |                       |                  |
| 003                   | RWT705160003<br>RO-1 SKID<br>CONSIST OF FRAME, RO PRESSURE VESSELS,<br>VALVES, PIPING & ETC.,<br>AS PER TECHNICAL SPECIFICATION NO.<br>ROS:6169 REV 00 DATED 27.06.2017,<br>ROS:4172 REV 00 DATED 23.06.2017 &<br>P&ID FOR PTWS :1-WT-150-01043 REV 00            | ST   | 2.00 |                       |                  |
| 004                   | RWT705160004<br>VALVES FOR LP & HP PIPING<br>(SKID OUT SIDE)<br>AS PER TECHNICAL SPECIFICATION NO.<br>ROS:6169 REV 00 DATED 27.06.2017,<br>ROS:4172 REV 00 DATED 23.06.2017 &<br>P&ID FOR PTWS :1-WT-150-01043 REV 00                                             | ST   | 1.00 |                       |                  |
| 005                   | RWT705160005<br>INTER CONNECTING LP<br>(SS 316 SCH.10) & HP PIPING<br>(SKID OUT SIDE)<br>FOR RO STAGE-1,<br>AS PER TECHNICAL SPECIFICATION NO.<br>ROS:6169 REV 00 DATED 27.06.2017,<br>ROS:4172 REV 00 DATED 23.06.2017 &<br>P&ID FOR PTWS :1-WT-150-01043 REV 00 | ST   | 1.00 |                       |                  |
| 006                   | RWT705160006<br>MEMBRANE FOR RO STAGE-1 SKID<br>AS PER TECHNICAL SPECIFICATION NO.<br>ROS:6169 REV 00 DATED 27.06.2017.                                                                                                                                           | ST   | 2.00 |                       |                  |
| 007                   | RWT705160007<br>ELECTRICAL CONTROL & INSTRUMENTATION<br>FOR RO STAGE-1<br>AS PER TECHNICAL SPECIFICATION NO.<br>ROS:6169 REV 00 DATED 27.06.2017,<br>ROS:4172 REV 00 DATED 23.06.2017 &<br>P&ID FOR PTWS :1-WT-150-01043 REV 00                                   | ST   | 1.00 |                       |                  |
| 008                   | RWT705160008<br>VFD PANEL FOR RO STAGE-1 HP PUMP<br>AS PER TECHNICAL SPECIFICATION NO.<br>ROS:6169 REV 00 DATED 27.06.2017,<br>ROS:4172 REV 00 DATED 23.06.2017.                                                                                                  | ST   | 1.00 |                       |                  |

**ANNEXURE - D**  
**BHEL : BAP : RANIPET**  
**PURCHASE - DESALINATION**  
**PRICE OFFER FORMAT**  
**DESIGN, MANUFACTURING, TESTING & SUPPLY OF**  
**RO SYSTEM FOR PTWS & ETP INCLUDING ALL ACCESSORIES**  
**FOR KECL TANZANIA 371.2MW CCP PROJECT**  
**(INTERNATIONAL ORDER)**  
**Enquiry No. 7770668E DATED 19-JUL--2017 Due Date 17-AUG-2017 (NIT\_33778)**

**PRICE OFFER - SUPPLY**

| Enquiry Sl. No. | Description                                                                                                                                                                                                                                   | Unit | Qty. | Rate / Unit in Rs. | Amount in Rs. |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|--------------------|---------------|
| 009             | RWT705160009<br>CARTRIDGE FOR RO STAGE-2, WITH ELEMENTS, AIR VENT DRAIN VALVE & ETC., AS PER TECHNICAL SPECIFICATION NO. ROS:6169 REV 00 DATED 27.06.2017, ROS:4172 REV 00 DATED 23.06.2017.                                                  | ST   | 3.00 |                    |               |
| 010             | RWT705160010<br>RO STAGE-2 HIGH PRESSURE PUMP WITH VFD MOTOR ASSEMBLY & ACCESSORIES AS PER TECHNICAL SPECIFICATION NO. ROS:6169 REV 00 DATED 27.06.2017, ROS:4172 REV 00 DATED 23.06.2017.                                                    | ST   | 3.00 |                    |               |
| 011             | RWT705160011<br>RO-2 SKID<br>CONSIST OF FRAME, RO PRESSURE VESSEL, VALVES, PIPING, ETC., AS PER TECHNICAL SPECIFICATION NO. ROS:6169 REV 00 DATED 27.06.2017, ROS:4172 REV 00 DATED 23.06.2017 & P&ID FOR PTWS :1-WT-150-01043 REV 00         | ST   | 2.00 |                    |               |
| 012             | RWT705160012<br>VALVES FOR LP & HP PIPING (SKID OUT SIDE) FOR RO STAGE-2, AS PER TECHNICAL SPECIFICATION NO. ROS:6169 REV 00 DATED 27.06.2017, ROS:4172 REV 00 DATED 23.06.2017 & P&ID FOR PTWS :1-WT-150-01043 REV 00                        | ST   | 1.00 |                    |               |
| 013             | RWT705160013<br>LP (SS 316 SCH. 10) & HP INTER CONNECTING PIPING (SKID OUT SIDE) FOR RO STAGE-2, AS PER TECHNICAL SPECIFICATION NO. ROS:6169 REV 00 DATED 27.06.2017, ROS:4172 REV 00 DATED 23.06.2017 & P&ID FOR PTWS :1-WT-150-01043 REV 00 | ST   | 1.00 |                    |               |
| 014             | RWT705160014<br>MEMBRANE FOR RO STAGE-2 AS PER TECHNICAL SPECIFICATION NO. ROS:6169 REV 00 DATED 27.06.2017.                                                                                                                                  | ST   | 2.00 |                    |               |
| 015             | RWT705160015<br>ELECTRICAL, CONTROL & INSTRUMENTAION AS PER TECHNICAL SPECIFICATION NO. ROS:6169 REV 00 DATED 27.06.2017, ROS:4172 REV 00 DATED 23.06.2017 & P&ID FOR PTWS :1-WT-150-01043 REV 00                                             | ST   | 1.00 |                    |               |
| 016             | RWT705160016<br>VFD PANEL FOR RO STAGE-2 HP PUMP AS PER TECHNICAL SPECIFICATION NO. ROS:6169 REV 00 DATED 27.06.2017, ROS:4172 REV 00 DATED 23.06.2017 & P&ID FOR PTWS :1-WT-150-01043 REV 00                                                 | ST   | 1.00 |                    |               |

**ANNEXURE - D**  
**BHEL : BAP : RANIPET**  
**PURCHASE - DESALINATION**  
**PRICE OFFER FORMAT**  
**DESIGN, MANUFACTURING, TESTING & SUPPLY OF**  
**RO SYSTEM FOR PWTS & ETP INCLUDING ALL ACCESSORIES**  
**FOR KECL TANZANIA 371.2MW CCP PROJECT**  
**(INTERNATIONAL ORDER)**  
**Enquiry No. 7770668E DATED 19-JUL--2017 Due Date 17-AUG-2017 (NIT\_33778)**

**PRICE OFFER - SUPPLY**

| Enquiry Sl. No. | Description                                                                                                                                                                                                                                              | Unit | Qty. | Rate / Unit in Rs. | Amount in Rs. |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|--------------------|---------------|
| 017             | RWT705160017<br>CARTRIDGE FILER<br>FOR ETP RO SYSTEM, WITH ELEMENTS ,<br>AIR VENT, DRAIN VALVE & ETC.,<br>AS PER TECHNICAL SPECIFICATION NO.<br>ROS:6170 REV 00 DATED 27.06.2017 &<br>ROS:4172 REV 00 DATED 23.06.2017                                   | ST   | 3.00 |                    |               |
| 018             | RWT705160018<br>ETP RO HIGH PRESSURE PUMP WITH VFD<br>MOTOR ASSEMBLY & ACCESSORIES,<br>AS PER TECHNICAL SPECIFICATION NO.<br>ROS:6170 REV 00 DATED 27.06.2017 &<br>ROS:4172 REV 00 DATED 23.06.2017                                                      | ST   | 3.00 |                    |               |
| 019             | RWT705160019<br>RO SKID FOR ETP,<br>CONSIST OF SKID FRAME, RO PRESSURE VESSEL,<br>VALVES, PIPING & ETC.,<br>AS PER TECHNICAL SPECIFICATION NO.<br>ROS:6170 REV 00 DATED 27.06.2017 &<br>ROS:4172 REV 00 DATED 23.06.2017                                 | ST   | 2.00 |                    |               |
| 020             | RWT705160020<br>VALVES FOR ETP RO LP &<br>HP PIPING (SKID OUT SIDE)<br>AS PER TECHNICAL SPECIFICATION NO.<br>ROS:6170 REV 00 DATED 27.06.2017,<br>ROS:4172 REV 00 DATED 23.06.2017 &<br>P&ID FOR ETP :1-WT-060-01044 REV 00                              | ST   | 1.00 |                    |               |
| 021             | RWT705160021<br>INTER CONNECTING LP &<br>HP (SS 316 SCH.10) PIPING<br>FOR ETP RO (SKID OUT SIDE)<br>AS PER TECHNICAL SPECIFICATION NO.<br>ROS:6170 REV 00 DATED 27.06.2017,<br>ROS:4172 REV 00 DATED 23.06.2017 &<br>P&ID FOR ETP :1-WT-060-01044 REV 00 | ST   | 1.00 |                    |               |
| 022             | RWT705160022<br>RO MEMBRANE FOR ETP RO SYSTEM,<br>AS PER TECHNICAL SPECIFICATION NO.<br>ROS:6170 REV 00 DATED 27.06.2017.                                                                                                                                | ST   | 2.00 |                    |               |
| 023             | RWT705160023<br>ELECTRICAL, CONTROLS & INSTRUMENTATION,<br>AS PER TECHNICAL SPECIFICATION NO.<br>ROS:6170 REV 00 DATED 27.06.2017,<br>ROS:4172 REV 00 DATED 23.06.2017 &<br>P&ID FOR ETP :1-WT-060-01044 REV 00                                          | ST   | 1.00 |                    |               |
| 024             | RWT705160024<br>VFD PANEL FOR ETP RO HP PUMP<br>AS PER TECHNICAL SPECIFICATION NO.<br>ROS:6170 REV 00 DATED 27.06.2017 &<br>ROS:4172 REV 00 DATED 23.06.2017                                                                                             | ST   | 1.00 |                    |               |

| <p style="text-align: center;"><b>ANNEXURE - D</b><br/> <b>BHEL : BAP : RANIPET</b><br/> <b>PURCHASE - DESALINATION</b><br/> <b>PRICE OFFER FORMAT</b><br/> <b>DESIGN, MANUFACTURING, TESTING &amp; SUPPLY OF</b><br/> <b>RO SYSTEM FOR PWTS &amp; ETP INCLUDING ALL ACCESSORIES</b><br/> <b>FOR KECL TANZANIA 371.2MW CCP PROJECT</b><br/> <b>(INTERNATIONAL ORDER)</b><br/> <b>Enquiry No. 7770668E DATED 19-JUL--2017 Due Date 17-AUG-2017 (NIT_33778)</b></p> |                                                                                                                                                                                                                                                                                                |             |             |                               |                          |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-------------|-------------------------------|--------------------------|
| <b>PRICE OFFER - SUPPLY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                |             |             |                               |                          |
| <b>Enquiry<br/>Sl.<br/>No.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>Description</b>                                                                                                                                                                                                                                                                             | <b>Unit</b> | <b>Qty.</b> | <b>Rate / Unit<br/>in Rs.</b> | <b>Amount in<br/>Rs.</b> |
| 025                                                                                                                                                                                                                                                                                                                                                                                                                                                               | RWT705160025<br>FRP TANK 5 CU.M CAPACITY<br>FOR RO CIP CLEANING<br>AS PER TECHNICAL SPECIFICATION NO.<br>ROS:6169 REV 00 DATED 27.06.2017,                                                                                                                                                     | ST          | 1.00        |                               |                          |
| 026                                                                                                                                                                                                                                                                                                                                                                                                                                                               | RWT705160026<br>RO CIP CARTRIDGE FILTER WITH ELEMENT, AIR<br>VENT, DRAIN VALVE,<br>AS PER TECHNICAL SPECIFICATION NO.<br>ROS:6169 REV 00 DATED 27.06.2017,                                                                                                                                     | ST          | 1.00        |                               |                          |
| 027                                                                                                                                                                                                                                                                                                                                                                                                                                                               | RWT705160027<br>RO CIP FEED PUMP<br>WITH MOTOR ASSEMBLY & ACCESSORIES<br>AS PER TECHNICAL SPECIFICATION NO.<br>ROS:6169 REV 00 DATED 27.06.2017,                                                                                                                                               | ST          | 2.00        |                               |                          |
| 028                                                                                                                                                                                                                                                                                                                                                                                                                                                               | RWT705160028<br>FOUNDATION BOLTS<br>FOR PWTS & ETP EQUIPMENTS<br>(CARTRIDGE FILTERS, HP PUMPS, RO-1&2 SKID,<br>ETP RO SKID, CARTRIDGE FILTER,<br>CIP FEED PUMP & GRP TANK ETC.<br>AS PER TECHNICAL SPECIFICATION NO.<br>ROS:6169 REV 00 DATED 27.06.2017 &<br>ROS:6170 REV 00 DATED 27.06.2017 | ST          | 1.00        |                               |                          |
| 029                                                                                                                                                                                                                                                                                                                                                                                                                                                               | RWT705160029<br>COMMISSIONING SPARES<br>AS PER TECHNICAL SPECIFICATION NO.<br>ROS:6169 REV 00 DATED 27.06.2017<br>ROS:6170 REV 00 DATED 27.06.2017 &<br>ROS:4172 REV 00 DATED 23.06.2017                                                                                                       | ST          | 1.00        |                               |                          |
| 030                                                                                                                                                                                                                                                                                                                                                                                                                                                               | RWT705160030<br>MANDATORY SPARES<br>AS PER TECHNICAL SPECIFICATION NO.<br>ROS:6169 REV 00 DATED 27.06.2017<br>ROS:6170 REV 00 DATED 27.06.2017 &<br>ROS:4172 REV 00 DATED 23.06.2017                                                                                                           | ST          | 1.00        |                               |                          |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>Total Price (Total of Sl. No. 001 - 030 )</b>                                                                                                                                                                                                                                               |             |             |                               |                          |



| <p align="center"> <b>ANNEXURE - D</b><br/> <b>BHEL : BAP : RANIPET</b><br/> <b>PURCHASE - DESALINATION</b><br/> <b>PRICE OFFER FORMAT</b><br/> <b>DESIGN, MANUFACTURING, TESTING &amp; SUPPLY OF</b><br/> <b>RO SYSTEM FOR PWTS &amp; ETP INCLUDING ALL ACCESSORIES</b><br/> <b>FOR KECL TANZANIA 371.2MW CCP PROJECT</b><br/> <b>(INTERNATIONAL ORDER)</b><br/> <b>Enquiry No. 7770668E DATED 19-JUL--2017 Due Date 17-AUG-2017 (NIT_33778)</b> </p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |             |             |                               |                          |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-------------|-------------------------------|--------------------------|
| <b>PRICE OFFER - SUPPLY</b>                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |             |             |                               |                          |
| <b>Enquiry<br/>Sl.<br/>No.</b>                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Unit</b> | <b>Qty.</b> | <b>Rate / Unit<br/>in Rs.</b> | <b>Amount in<br/>Rs.</b> |
| <b>PRICE OFFER - SERVICE</b>                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |             |             |                               |                          |
| <b>Enquiry<br/>Sl.<br/>No.</b>                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Unit</b> | <b>Qty.</b> | <b>Rate / Unit<br/>in Rs.</b> | <b>Amount in<br/>Rs.</b> |
| 031                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <p>RWT705160031<br/> TECHNICAL ADVISORY SERVICES<br/> FOR PWTS- ERECTION STAGE CLEARANCE,<br/> COMMISSIONING,<br/> POST COMMISSIONING/ PG TEST<br/> AT KILWA SITE,<br/> AS PER TECHNICAL SPECIFICATION NO. ROS:6169 REV<br/> 00 DATED 27.06.2017,<br/> ROS:4172 REV 00 DATED 23.06.2017.</p> <p><i>(Technical assistance for maximum of fifteen days<br/> (comprising three visits &amp; excluding travels and holidays) at<br/> Kilwa site for erection stage clearance, commissioning, post<br/> commissioning / PG test. Vendor to include travel to &amp; fro<br/> charges, lodging, local conveyance etc., for the above.)</i></p> <p>ALSO VENDOR TO PROVIDE BREAK-UP PRICE FOR<br/> THE TECHNICAL ADVISORY SERVICES.</p>   | ST          | 1.00        |                               |                          |
| 032                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <p>RWT705160032<br/> TECHNICAL ADVISORY SERVICES<br/> FOR ETP - ERECTION STAGE CLEARANCE,<br/> COMMISSIONING,<br/> POST COMMISSIONING/PG TEST<br/> AT KILWA SITE<br/> AS PER TECHNICAL SPECIFICATION NO. ROS:6170 REV<br/> 00 DATED 27.06.2017 &amp;<br/> ROS:4172 REV 00 DATED 23.06.2017</p> <p><i>(Technical assistance for maximum of fifteen days<br/> (comprising three visits &amp; excluding travels and holidays) at<br/> Kilwa site for erection stage clearance, commissioning, post<br/> commissioning / PG test. Vendor to include travel to &amp; fro<br/> charges, lodging, local conveyance etc., for the above.)</i></p> <p>ALSO VENDOR TO PROVIDE BREAK-UP PRICE FOR<br/> THE TECHNICAL ADVISORY SERVICES.</p> | ST          | 1.00        |                               |                          |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>Total Price (Total of Sl. No. 031 &amp; 032 )</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |             |             |                               |                          |

**ANNEXURE - D**  
**BHEL : BAP : RANIPET**  
**PURCHASE - DESALINATION**  
**PRICE OFFER FORMAT**  
**DESIGN, MANUFACTURING, TESTING & SUPPLY OF**  
**RO SYSTEM FOR PWTS & ETP INCLUDING ALL ACCESSORIES**  
**FOR KECL TANZANIA 371.2MW CCP PROJECT**  
**(INTERNATIONAL ORDER)**  
**Enquiry No. 7770668E DATED 19-JUL--2017 Due Date 17-AUG-2017 (NIT\_33778)**

**PRICE OFFER - SUPPLY**

| Enquiry Sl. No.             | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Unit | Qty. | Rate / Unit in Rs. | Amount in Rs. |
|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|--------------------|---------------|
| OPTIONAL PRICE              | RECOMMENDED SPARES FOR 2 YEARS O&M -LIST OF SPARES WITH PRICE BREAKUP TO BE FURNISHED<br><br>NOTE: THIS ITEM WILL BE ORDERED IF REQUIRED ONLY AND THIS ITEM WILL NOT BE CONSIDERED FOR ARRIVING RANKING                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | SET  | 1.00 |                    |               |
| OPTIONAL PRICE              | TECHNICAL ADVISORY SERVICES FOR ADDITIONAL VISIT (ONE VISIT CONSIST OF MINIMUM THREE DAYS EXCLUDING TRAVELS AND HOLIDAYS) WHICH INCLUDE TRAVEL TO & FRO CHARGES, LODGING, LOCAL CONVEYANCE ETC.<br><br>ALSO VENDOR TO PROVIDE BREAK-UP PRICE FOR THE ADDITIONAL VISIT.<br><br>NOTE: THIS ITEM WILL BE ORDERED IF REQUIRED ONLY AND THIS ITEM WILL NOT BE CONSIDERED FOR ARRIVING RANKING                                                                                                                                                                                                                                                                                                             | SET  | 1.00 |                    |               |
| IMPORTANT NOTES             | 1) All the Items are to be inspected by BHEL Engineers / BHEL Authorized Engineer and Customer / Consultant Engineer either jointly or individually before the despatch of the item at vendor works as per approved QAP.<br>2) All Items will be compared on SET Basis & Order will be placed on a Single vendor who is the lowest (L1) on set basis.<br>3) Please confirm the supply completion with in 30.01.2018 or 5 Months from the date of Manufacturing clearance, which ever is Later.<br>4) Vendor can also quote improved delivery date if any from the date of Manufacturing Clearance,<br>5) Commissioning Spares & Mandatory spares List and the individual price should be indicated.. |      |      |                    |               |
| Signature & Seal of Offerer |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |      |      |                    |               |

| ANNEXURE - E<br>SPECIFICATION DEVIATION DISPOSITION REPORT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |        |                                                                                                                                                                       |                     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| Enquiry No. 7770668E DATED 19-JUL-2017<br>Due Date 17-AUG-2017 (NIT_33778)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |        | DESIGN, MANUFACTURING, TESTING & SUPPLY OF<br>RO SYSTEM FOR PWTS & ETP INCLUDING ALL<br>ACCESSORIES<br>FOR KECL TANZANIA 371.2MW CCP PROJECT<br>(INTERNATIONAL ORDER) | Vendor Name         |
| 01. ROS:6169 REV 00 DATED 27.06.2017 - TECHNICAL SPECIFICATION FOR PTWS,<br>02. ROS:6170 REV 00 DATED 27.06.2017 - TECHNICAL SPECIFICATION FOR ETP<br>03. ROS:4172 REV 00 DATED 23.06.2017 - E, C & I<br>04. P & ID FOR RO - PWTS 1 WT 150 01043 REV 00<br>05. P & ID FOR RO - ETP 1-WT-060-01044 REV 00<br>06. P & ID BOQ FOR PWTS - ANNEXURE - A<br>07. P & ID BOQ FOR ETP - ANNEXURE - A<br>08. VENDOR LIST 280617,<br>09. SEAWORTHY PACKING SPECIFICATION<br>PE TS 888 100 A001 REV 00,<br>10. QUALIFICATION REQUIREMENT RO SYSTEM ANNEXURE III,<br>11. MANDATORY SPARES ANNEXURE II. |        |                                                                                                                                                                       |                     |
| Page                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Clause | Details Of Deviation With Reason                                                                                                                                      | Disposition By BHEL |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |        |                                                                                                                                                                       |                     |
| Signature Of Vendor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |        |                                                                                                                                                                       | Reviewed By         |
| “ AGREED DEVIATION “                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |        |                                                                                                                                                                       | APPROVED BY         |
| if any to be incorporated in the PO in the event of order.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |        |                                                                                                                                                                       |                     |

Date :

VENDOR's SIGNATURE WITH SEAL

*(TO BE STAMPED IN ACCORDANCE WITH STAMP ACT AND THE EXPIRY DATE OF BG MUST BE AFTER 3 MONTHS FROM THE DATE OF COMPLETION OF SUPPLIES)*

### **CONTRACT EXECUTION BANK GUARANTEE**

In accordance of M/s. Bharat Heavy Electricals Limited (A Government of India undertaking, a company incorporated under the Companies Act 1956 having its Registered Office at "BHEL House", SIRI Fort, New Delhi 110 049) through its Boiler Auxiliaries Plant located at Ranipet – 632 406, (hereinafter called 'the Company') having entered into a contract with M/s.....  
..... hereinafter called 'the said contractor' which term includes 'suppliers' for the purpose of this Bond and under the terms and conditions of the Contract No.....Dt.....between BHEL, Ranipet and as per the Contract, the Contractor / Supplier is to furnish a Contract Execution Bank Guarantee for Rs.....in words.....  
.....for the due performance of the contract and for the fulfillment of all the terms and conditions of the contract.

Sign and seal of issuing bank  
Please affix Non Judicial Stamp  
here, as per Stamp Act

Bank Guarantee No.....Date.....Banker Name.....  
Bank Guarantee Value Rs.....

1. We.....  
.....  
.....(Bank's name, Branch, Place – address to be mentioned [herein after referred to as the Bank) at the request of.....  
.....(Contractor(s)] do hereby undertake to pay the company an amount not exceeding Rs.....in words  
.....  
.....  
.....against any loss or damage caused to or suffered or would be caused to or suffered by the company by reason of any breach by the said Contractor(s) of any of the terms and conditions contained in the said agreement.

2. We.....  
.....  
.....(name of the bank with full address), do hereby undertake to pay the amounts due and payable under this guarantee without any demur, merely on a demand from the Company stating that the amount claimed is due by way of loss or damage caused to or would be caused to or suffered by the Company by reason of breach by the said Contractor(s) of any of the terms and conditions contained in the said Agreement or by the reason of the Contractor(s) 'failure to perform' the said agreement. Any such demand made on the Bank shall be conclusive as regards the amount due and payable by the Bank under this guarantee. However, our liability under this guarantee shall be restricted to an amount not exceeding Rs.....in words.....  
.....

Sign and seal of issuing bank

Bank Guarantee No.....Date.....Banker Name.....  
Bank Guarantee Value Rs.....

3. We undertake to pay conditionally to the Company any money so demanded notwithstanding any dispute(s) raised by the Contractor in any suit, or proceedings pending before any Court or Tribunal or Arbitration or before any other authority relating thereto our liability under this present being absolute and unequivocal. The payment under this guarantee would not wait till the disputes have been decided by any Court or Tribunal or in the arbitration proceedings or by any other authority. The payment so made by us under this Bond shall be a valid discharge of liability for payment thereunder and the Contractor(s) shall have no claim against us for making such payment.

4. We.....(name of Bank), further agree that the guarantee herein contained shall remain in full force and effect during the period that would be taken for the performance of the said Agreement and that it shall continue to be enforceable till all the dues of the Company under or by virtue of the said Agreement have been fully paid and its claims satisfied or discharged or till Purchase Department of the Company certifies that the terms and conditions of the said Agreement have been fully and properly carried out by the said Contractor(s) and accordingly discharges this guarantee.

5. (i) Unless a demand or claim under this guarantee is made on us in writing on or before .....(date) (After 3 months from the date of completion of supplies) we shall be discharged from all the liability under this guarantee thereafter. But where such claim or demand has been preferred by the Company with the Bank before the expiry of the said date, the claim shall be enforceable notwithstanding the fact that the said enforcement is effected after the said date. (ii) For the purpose of this clause, any letter making demand on the Bank by M/s. BHEL dispatched by Registered Post with Ack. Due or by Telegram or by any Electronic media addressed to the above mentioned address of the Bank shall be deemed to be the claim / demand in writing referred to above irrespective of the fact as to whether and when the said letter reaches the Bank, as also any letter containing the said demand or claim is lodged with the Bank personally.

Sign and seal of issuing bank

Bank Guarantee No.....Date.....Banker Name.....  
Bank Guarantee Value Rs.....

6. We.....(name of the Bank), further agree with the company that the Company shall have the fullest liberty without our consent and without affecting in any manner our obligations hereunder to vary any of the terms and conditions of the said agreement or to extend time of performance by the said Contractor(s) from time to time or to postpone for any time or from time to time any of the powers exercisable by the Company against the said Contractor(s) and to forbear or enforce any of the terms and conditions relating to the said Agreement and we shall not be relieved from our liability by any reason of any such variation or extension being granted to the said Contractor(s) or for any forbearance, act or omission on the part of the company or any indulgence by the company to the said Contractor(s) or by any such matter or thing whatsoever which under the law relating would, but for this provision, have effect of not so relieving us.

7. This guarantee will not be discharged due to the change in the constitution of the Bank or the Contractor(s).

8. The guarantee herein contained shall not be determined or affected by the liquidation or winding up or insolvency of or change in the constitution of the Contractor, but shall in all respects and for all purpose be binding and operative until all payments of all moneys due or that may hereafter become due to the said company or settled irrespective of any liability or obligation of the Contractor under the said Contract.

9. It shall not be necessary for the company to proceed against the Contractor before proceeding against the guarantor-bank and the guarantee herein contained shall be enforceable against them notwithstanding any security, which the company may have obtained from the Contractor shall, at the time when proceedings are taken against the Guarantor hereunder be outstanding or unrealized.

10. Any claim or dispute arising under the terms of this document shall only be enforced or settled in the Courts at Ranipet, Tamilnadu Jurisdiction.

11. The Bank declares that it has powers to issue this Guarantee under the Bank's Memorandum and Articles of Association and the undersigned has full powers to do so on its behalf under the power granted to him by the proper authorities of the Bank.

12. We .....(name of Bank) lastly undertake not to revoke this guarantee during its currency except with the previous consent of the company in writing.

In witness whereof we.....  
(name of Bank) have hereunto setout Bank Seal the.....  
day of.....month 20\_\_.

Sign and seal of issuing bank.



## **Online SRF Submission Procedure**

Following are the formalities to be completed by your company for registration purpose.

**NOTE: BEFORE PROCEEDING FOR ONLINE REGISTRATION " PLS READ STEPS FOR FILLING UP ONLINE REGISTRATION FORM - HELP MENU" - DETAILS ATTACHED WITH THIS MAIL**

With effect from 01.04.2015 onwards, we have migrated to online Supplier Registration Form (SRF) as per our Corporate guidelines. **Supplier Registration Form (SRF)** is to be fed in our BHEL website portal – **ie., PDF documents of SRF and its annexure as called for shall be signed by authorized signatory & uploaded in portal.**

We request to visit our Web Site : [www.bhel.com](http://www.bhel.com) and click under heading "Supplier Registration" and fill up the **"Supplier Registration Form"** which is available in the Online Supplier Registration Portal.

Or else, copy the following URL Link and paste in the web link address: [http://www.bhel.com/vender\\_registration/vender.php](http://www.bhel.com/vender_registration/vender.php) and proceed with.

Or else, type directly as <http://203.129.195.108>

**Click the button "search material"** on the home page of supplier registration portal and search thoroughly your required material / product

*After completing the material search then proceed for User Id & Password for filling up the details of registration requirements. **Note: If you are an already registered supplier with any of our BHEL Unit - pls select "existing permanent supplier" or else select "New Registration" and then proceed accordingly.***

**Please note that for a foreign suppliers' there is a separate format to be filled in, which may be taken care suitably.**

After successful submission of SRF along with all annexures as called for thro' online i.e., authorized signatory signed pdf documents of SRF and its annexures are to be uploaded thro' online portal and confirm the same in **"form dispatch"** area ie., registration part-4 – wherein supplier has to confirm that all the documents were submitted "online" and click the button **"confirm"**. After clicking confirmation button, the same will be appearing against BHEL Ranipet for registration.

Looking for a long successful & sustaining business association with BHEL.

## **INTEGRITY PACT**

### **Between**

Bharat Heavy Electricals Ltd. (BHEL), a company registered under the Companies Act 1956 and having its registered office at "BHEL House", Siri Fort, New Delhi – 110049 (India) hereinafter referred to as "The Principal", which expression unless repugnant to the context or meaning hereof shall include its successors or assigns of the ONE PART

### **and**

\_\_\_\_\_, (description of the party along with address), hereinafter referred to as "The Bidder/ Contractor" which expression unless repugnant to the context or meaning hereof shall include its successors or assigns of the OTHER PART

### **Preamble**

The Principal intends to award, under laid-down organizational procedures, contract/s for

\_\_\_\_\_  
\_\_\_\_\_. The Principal values full compliance with all relevant laws of the land, rules and regulations, and the principles of economic use of resources, and of fairness and transparency in its relations with its Bidder(s)/ Contractor(s).

In order to achieve these goals, the Principal will appoint Independent External Monitor(s), who will monitor the tender process and the execution of the contract for compliance with the principles mentioned above.

## **Section 1 – Commitments of the Principal**

- 1.1 The Principal commits itself to take all measures necessary to prevent corruption and to observe the following principles:-
  - 1.1.1 No employee of the Principal, personally or through family members, will in connection with the tender for, or the execution of a contract, demand, take a promise for or accept, for self or third person, any material or immaterial benefit which the person is not legally entitled to.
  - 1.1.2 The Principal will, during the tender process treat all Bidder(s) with equity and reason. The Principal will in particular, before and during the tender process, provide to all Bidder(s) the same information and will not provide to any Bidder(s) confidential / additional information through which the Bidder(s) could obtain an advantage in relation to the tender process or the contract execution.
  - 1.1.3 The Principal will exclude from the process all known prejudiced persons.
- 1.2 If the Principal obtains information on the conduct of any of its employees which is a penal offence under the Indian Penal Code 1860 and Prevention of Corruption Act 1988 or any other statutory penal enactment, or if there be a substantive suspicion in this regard, the Principal will inform its Vigilance Office and in addition can initiate disciplinary actions.

## **Section 2 – Commitments of the Bidder(s)/ Contractor(s)**

- 2.1 The Bidder(s)/ Contractor(s) commit himself to take all measures necessary to prevent corruption. He commits himself to observe the following principles during his participation in the tender process and during the contract execution.
  - 2.1.1 The Bidder(s)/ Contractor(s) will not, directly or through any other person or firm, offer, promise or give to the Principal or to any of the Principal's employees involved

in the tender process or the execution of the contract or to any third person any material, immaterial or any other benefit which he / she is not legally entitled to, in order to obtain in exchange any advantage of any kind whatsoever during the tender process or during the execution of the contract.

- 2.1.2 The Bidder(s)/ Contractor(s) will not enter with other Bidder(s) into any illegal or undisclosed agreement or understanding, whether formal or informal. This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of bids or any other actions to restrict competitiveness or to introduce cartelization in the bidding process.
- 2.1.3 The Bidder(s)/ Contractor(s) will not commit any penal offence under the relevant IPC/ PC Act; further the Bidder(s)/ Contractor(s) will not use improperly, for purposes of competition or personal gain, or pass on to others, any information or document provided by the Principal as part of the business relationship, regarding plans, technical proposals and business details, including information contained or transmitted electronically.
- 2.1.4 The Bidder(s)/ Contractor(s) will, when presenting his bid, disclose any and all payments he has made, and is committed to or intends to make to agents, brokers or any other intermediaries in connection with the award of the contract.
- 2.2 The Bidder(s)/ Contractor(s) will not instigate third persons to commit offences outlined above or be an accessory to such offences.



### **Section 3 – Disqualification from tender process and exclusion from future contracts**

If the Bidder(s)/ Contractor(s), before award or during execution has committed a transgression through a violation of Section 2 above, or acts in any other manner such as to put his reliability or credibility in question, the Principal is entitled to disqualify the Bidder(s)/ Contractor(s) from the tender process or take action as per the separate "Guidelines on Banning of Business dealings with Suppliers/ Contractors". framed by the Principal.

### **Section 4 – Compensation for Damages**

- 4.1 If the Principal has disqualified the Bidder from the tender process prior to the award according to Section 3, the Principal is entitled to demand and recover the damages equivalent Earnest Money Deposit/Bid Security.
- 4.2 If the Principal has terminated the contract according to Section 3, or if the Principal is entitled to terminate the contract according to section 3, the Principal shall be entitled to demand and recover from the Contractor liquidated damages equivalent to 5% of the contract value or the amount equivalent to Security Deposit/Performance Bank Guarantee, whichever is higher.

### **Section 5 – Previous Transgression**

- 5.1 The Bidder declares that no previous transgressions occurred in the last 3 years with any other company in any country conforming to the anti-corruption approach or with any other Public Sector Enterprise in India that could justify his exclusion from the tender process.
- 5.2 If the Bidder makes incorrect statement on this subject, he can be disqualified from the tender process or the contract, if already awarded, can be terminated for such reason.

## **Section 6 – Equal treatment of all Bidders/ Contractors/ Sub-contractors**

- 6.1 The Bidder(s)/ Contractor(s) undertake(s) to obtain from all subcontractors a commitment consistent with this Integrity Pact and report Compliance to the Principal. This commitment shall be taken only from those sub-contractors whose contract value is more than 20 % of Bidder's/ Contractor's contract value with the Principal. The Bidder(s)/ Contractor(s) shall continue to remain responsible for any default by his Sub-contractor(s).
- 6.2 The Principal will enter into agreements with identical conditions as this one with all Bidders and Contractors.
- 6.3 The Principal will disqualify from the tender process all bidders who do not sign this pact or violate its provisions.

## **Section 7 – Criminal Charges against violating Bidders/ Contractors /Sub-contractors**

If the Principal obtains knowledge of conduct of a Bidder, Contractor or Subcontractor, or of an employee or a representative or an associate of a Bidder, Contractor or Subcontractor which constitutes corruption, or if the Principal has substantive suspicion in this regard, the Principal will inform the Vigilance Office.

## **Section 8 –Independent External Monitor(s)**

- 8.1 The Principal appoints competent and credible Independent External Monitor for this Pact. The task of the Monitor is to review independently and objectively, whether and to what extent the parties comply with the obligations under this agreement.

- 8.2 The Monitor is not subject to instructions by the representatives of the parties and performs his functions neutrally and independently. He reports to the CMD, BHEL.
- 8.3 The Bidder(s)/ Contractor(s) accepts that the Monitor has the right to access without restriction to all contract documentation of the Principal including that provided by the Bidder(s)/ Contractor(s). The Bidder(s)/ Contractor(s) will grant the monitor, upon his request and demonstration of a valid interest, unrestricted and unconditional access to his contract documentation. The same is applicable to Sub-contractor(s). The Monitor is under contractual obligation to treat the information and documents of the Bidder(s)/ Contractor(s) / Sub-contractor(s) with confidentiality.
- 8.4 The Principal will provide to the Monitor sufficient information about all meetings among the parties related to the contract provided such meetings could have an impact on the contractual relations between the Principal and the Contractor. The parties offer to the Monitor the option to participate in such meetings.
- 8.5 As soon as the Monitor notices, or believes to notice, a violation of this agreement, he will so inform the Management of the Principal and request the Management to discontinue or take corrective action, or heal the situation, or to take other relevant action. The Monitor can in this regard submit non-binding recommendations. Beyond this, the Monitor has no right to demand from the parties that they act in a specific manner, refrain from action or tolerate action.
- 8.6 The Monitor will submit a written report to the CMD, BHEL within 8 to 10 weeks from the date of reference or intimation to him by the Principal and, should the occasion arise, submit proposals for correcting problematic situations.
- 8.7 The CMD, BHEL shall decide the compensation to be paid to the Monitor and its terms and conditions.
- 8.8 If the Monitor has reported to the CMD, BHEL, a substantiated suspicion of an offence under relevant IPC / PC Act, and the CMD, BHEL has not, within reasonable time, taken visible action to proceed against such offence or reported it to the Vigilance Office, the



Monitor may also transmit this information directly to the Central Vigilance Commissioner, Government of India.

8.9 The number of Independent External Monitor(s) shall be decided by the CMD, BHEL.

8.10 The word 'Monitor' would include both singular and plural.

## **Section 9 – Pact Duration**

9.1 This Pact begins and shall be binding on and from the submission of bid(s) by bidder(s). It expires for the Contractor 12 months after the last payment under the respective contract and for all other Bidders 6 months after the contract has been awarded.

9.2 If any claim is made / lodged during this time, the same shall be binding and continue to be valid despite the lapse of this pact as specified as above, unless it is discharged/ determined by the CMD, BHEL.

## **Section 10 – Other Provisions**

10.1 This agreement is subject to Indian Laws and jurisdiction shall be registered office of the Principal, i.e. New Delhi.

10.2 Changes and supplements as well as termination notices need to be made in writing. Side agreements have not been made.

10.3 If the Contractor is a partnership or a consortium, this agreement must be signed by all partners or consortium members.

10.4 Should one or several provisions of this agreement turn out to be invalid, the remainder of this agreement remains valid. In this case, the parties will strive to come to an agreement to their original intentions.



10.5 Only those bidders/ contractors who have entered into this agreement with the Principal would be competent to participate in the bidding. In other words, entering into this agreement would be a preliminary qualification.

-----

For & On behalf of the Principal

(Office Seal)

-----

For & On behalf of the Bidder/ Contractor

(Office Seal)

Place-----

Date-----

Witness: \_\_\_\_\_

(Name & Address) \_\_\_\_\_

\_\_\_\_\_

Witness: \_\_\_\_\_

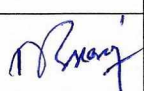
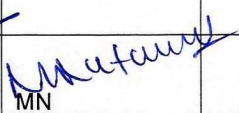
(Name & Address) \_\_\_\_\_

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|                                                                                   |                                       |                  |
|-----------------------------------------------------------------------------------|---------------------------------------|------------------|
|  | SPECIFICATION FOR<br>RO SYSTEM (PWTS) | SPEC.NO.ROS:6169 |
|                                                                                   |                                       | REV.: 00         |

**BHARAT HEAVY ELECTRICALS LIMITED,  
RANIPET- 632 406**

**TECHNICAL SPECIFICATION  
FOR  
REVERSE OSMOSIS DESALINATION PLANT  
KILWA PROJECT**

|        |          |                                                                                         |                                                                                        |                                                                                         |             |
|--------|----------|-----------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|-------------|
|        |          |                                                                                         |                                                                                        |                                                                                         |             |
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|        |          |                                                                                         |                                                                                        |                                                                                         |             |
| 00     | 27.06.17 | DBN  | PP  | MN  | Fresh issue |
| Rev.No | Date     | Prepared                                                                                | Checked                                                                                | Approved                                                                                | Remarks     |

|                                                                                   |                                       |                  |
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|  | SPECIFICATION FOR<br>RO SYSTEM (PWTS) | SPEC.NO.ROS:6169 |
|                                                                                   |                                       | REV.: 00         |

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## 1.0 **SCOPE OF SUPPLY**

The intent of this specification is to cover Design, Engineering, Manufacturing, shop testing, supply, and ensuring the performance of the Reverse Osmosis Desalination system as per this specification.

The scope shall fully cover the requirement of the Design Criteria and Technical requirement of this specification for treating the UF filtered water to meet the feed water requirement of Electro De Ionization System. The scope shall include but not limited to the following.

The RO Plant consists of 2x50% working streams of RO Stage-1 and 2x50% working streams of RO stage-2. UF treated water shall be used by RO stage -1 to produce permeate water. This permeate water shall be further treated by RO stage-2 to produce final permeate water as per the specified quality & quantity suitable for Electro De Ionization System feed water.

Supply of RO skid with necessary Pressure vessel & RO Membrane assembly, piping, valves, electrical & controls and Instrumentation as per Piping and instrumentation diagram No: 1-WT-150-01043,Rev.00.

The scope of supply broadly covers the following items.

- 1) 3x50% cartridge filters with element, air vent & drain valves for stage- I
- 2) 3x50% High pressure pumps with VFD-motor for RO stage-1 and accessories along with suction & discharge piping & valves for stage I
- 3) VFD panel for RO stage-I HP Pumps -1 set
- 4) 2x50% RO skid with pressure vessels, piping, instruments, valves, etc., for RO stage I – 2 sets
- 5) Membrane for RO Stage-I – 2 sets
- 6) Valves for LP & HP piping for RO stage-I – 1 set
- 7) Interconnecting piping for RO stage-I – 1set (LP piping SS 316 sch.10 from Cartridge filters outlet as per PWTS P&ID)
- 8) Interconnecting HP piping (SS 316L) from HP pumps to RO stage- I skid – 1 set
- 9) 3x50% Cartridge filters with element, air vent & drain valves for stage II
- 10) 2x50% High pressure pumps with motors, VFD and accessories along with suction & discharge piping & valves for RO stage II
- 11) VFD panel for RO stage-II HP Pumps -1 set
- 12) 2x50% RO-II skid with pressure vessels, piping, FCV, instruments, valves, etc., for RO stage-II – 2 set.
- 13) Membrane for RO stage-II – 2 sets

|                                                                                   |                                       |                  |
|-----------------------------------------------------------------------------------|---------------------------------------|------------------|
|  | SPECIFICATION FOR<br>RO SYSTEM (PWTS) | SPEC.NO.ROS:6169 |
|                                                                                   |                                       | REV.: 00         |

- 14) Valves for LP & HP piping for RO stage-2 – 1 set
- 15) Interconnecting piping for RO stage-II – 1set (LP piping SS 316 sch.10 from Cartridge filters outlet as per PWTS P&ID)
- 16) Interconnecting HP piping (SS 316L) from HP pumps to RO stage- II skid – 1 set.
- 17) Electricals controls & instrumentation as per P&ID and ROS:4172 - 1sets
- 18) CIP system common for both PWTS ( RO stage-I, II & EDI ) & ETP-RO system consist of CIP Pump & motors with base frame (1W+1S), CIP tank (MOC: FRP), Chemical cleaning cartridge filter housing -1 set with air vent & drain valve and cartridge elements.
- 19) Foundation bolts , fasteners & gaskets for all equipment's of PWTS & ETP – 1 set
- 20) Commissioning spares as per specification 1-set
- 21) Mandatory spares as per specification -1 set
- 22) Technical advisory Services for both PWTS & ETP, erection stage clearance, commissioning, post commissioning/PG Test for RO system.
- 23) Items though not mentioned, but needed to make the system complete as stipulated under these specifications are also to be furnished unless otherwise specifically excluded.

## 1.2 GENERAL

- a. The permeate water from the RO stage -1 will be passed through degasser tower & collected at product water storage tank (RCC).
- b. The permeate water from RO stage - 2 will be stored in RO-2 permeate Water Storage Tank (MSRL) and it will be further treated through Electro De Ionization system.
- c. It is not the intent to specify all the details of the design & manufacture. However, the equipment shall conform in all respects to high standard of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to Engineer / Customer, who will interpret the meaning of drawing & the specification and shall be entitled to reject any work or material, which is not in full accordance herewith.
- d. In case of any deviation, the Bidder shall indicate the same, clause by clause in the deviation schedule. In the absence of the same it will be construed that the bid confirms strictly to the specification.

|                                                                                   |                                       |                  |
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- e. The order of priority of this specification is as follows:
  1. Equipment Specification,
  2. P&ID and Layout
  3. General design requirements
- f. Any contradiction either between various parts or contents of the specification shall be a matter for clarification to be obtained by the bidder. The Customer's decision shall be final. However, as a general guideline the details furnished in the Equipment specification shall prevail.
- g. General terms & conditions, instructions to the tenderer & other attachments referred to elsewhere are part of this specification.

## 2.0 **PROJECT INFORMATION**

- 2.1 Owner : Kilwa Energy Company Ltd.,  
Tanzania
- 2.2 Project Title : 1x371.2 MW natural gas  
based combined power plant
- 2.3 Plant location : Kilwa Dist, Tanzania, Africa  
Continent.
- 2.4 System : Plant water system / ETP
- 2.5 Vendor scope : Chennai / Mumbai Sea port

|                                                                                   |                                       |                  |
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### 3.0 TECHNICAL REQUIREMENT

#### 3.1 RO PLANT CAPACITY

RO stage -1 shall produce 90 cum/hr of permeate of specified quality continuously by using UF treated water. RO stage – 2 shall produce 22 cum/ hr of permeate of specified quality continuously by using RO stage – 1 permeate as feed water.

The feed water quality for RO stage -1, Permeate quality & quantity of RO stage - 1 and RO stage -2 including the performance guarantee requirements are provided in detail in this spec.

#### 3.2 INLET WATER QUALITY FOR DESIGN OF RO STAGE- I:

| Sl. No | PARAMETERS                                  | UNIT | RESULT |
|--------|---------------------------------------------|------|--------|
| 1      | SDI <sub>15</sub>                           |      | ≤3.0   |
| 2      | pH Value                                    |      | 8.03   |
| 3      | Total Dissolved Solids (Note)               | ppm  | 910    |
| 4      | Alkalinity (HCO <sub>3</sub> <sup>-</sup> ) | ppm  | 106.1  |
| 5      | Chloride as Cl                              | ppm  | 447.9  |
| 6      | Sulphate as SO <sub>4</sub>                 | ppm  | 39.0   |
| 7      | Silica – Dissolved as SiO <sub>2</sub>      | ppm  | 15     |
| 8      | Silica – Colloidal as SiO <sub>2</sub>      | ppm  | 4      |
| 9      | Calcium as Ca                               | ppm  | 48.1   |
| 10     | Magnesium -Mg                               | ppm  | 33.0   |
| 11     | Total Hardness                              | ppm  | 300    |
| 12     | Sodium-Na                                   | ppm  | 231.0  |
| 13     | Ammonical Nitrogen                          | ppm  | 0.21   |
| 14     | Iron as Fe                                  | ppm  | 0.1    |
| 15     | Manganese as Mn                             | ppm  | 0.0    |
| 16     | Total Kjeldhal Nitrogen                     | ppm  | 0.0    |



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| Sl. No | PARAMETERS                                              | UNIT  | RESULT |
|--------|---------------------------------------------------------|-------|--------|
| 17     | Total Residual Chlorine                                 | ppm   | 0.5    |
| 18     | Permanganate as KMnO <sub>4</sub>                       | ppm   | 2.1    |
| 19     | Phosphate as PO <sub>4</sub>                            | ppm   | 0.0    |
| 20     | Free Ammonia                                            | ppm   | <0.5   |
| 21     | Total Phosphorous                                       | ppm   | 0.0    |
| 22     | Oil & Grease                                            | ppm   | 0.0    |
| 23     | Nitrate Nitrogen                                        | ppm   | 1.13   |
| 24     | Potassium-K <sup>+</sup>                                | Ppm   | 2.3    |
| 25     | Fluoride as F                                           | ppm   | 0.0    |
| 26     | Copper as Cu                                            | ppm   | 0.0    |
| 27     | Zinc as Zn                                              | ppm   | 0.0    |
| 28     | Lead as Pb                                              | ppm   | 0.0    |
| 29     | Total Chromium as Cr                                    | ppm   | 0.0    |
| 30     | Mercury as Hg                                           | ppm   | 0.0    |
| 31     | Cyanide as CN                                           | ppm   | 0.0    |
| 32     | Phenolic Components as C <sub>6</sub> H <sub>5</sub> OH | ppm   | 0.0    |
| 33     | Nickel as Ni                                            | ppm   | 0.0    |
| 34     | Arsenic as As                                           | ppm   | 0.0    |
| 35     | Temperature                                             | Deg C | 29-31  |



|                                                                                   |                                       |                  |
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### 3.3 PERFORMANCE & GUARANTEE REQUIREMENT OF RO SYSTEM

The design should meet the outlet water quality at RO outlet as indicated below.

#### 3.3.1 RO Stage - I

##### GUARANTEED RO OUTLET WATER QUALITY & QUANTITY

| S. No | Description                                                | Unit               | Value |
|-------|------------------------------------------------------------|--------------------|-------|
| 01    | RO permeate TDS at the end of membrane life & at 25 deg. C | ppm                | ≤ 80  |
| 02    | Permeate output per stream                                 | m <sup>3</sup> /hr | 45    |
| 03    | RO plant recovery per stream                               | %                  | 75    |

#### 3.3.2 RO Stage II

##### GUARANTEED RO OUTLET WATER QUALITY& QUANTITY

| S. No | Description                                                | Unit               | Value |
|-------|------------------------------------------------------------|--------------------|-------|
| 01    | RO permeate TDS at the end of membrane life & at 25 deg. C | ppm                | ≤10   |
| 02    | Permeate output per stream                                 | m <sup>3</sup> /hr | 11    |
| 03    | RO plant recovery per stream                               | %                  | 90    |

#### **Note:**

All the sub-vendor must have supplied equipment for a similar duty and application with proven experience. These manufacturers / suppliers / sub-vendors should have received ISO 9000 qualification (certification of approval) from International Standard Organization, at least three (3) years old and such qualifications are currently valid. The vendor shall provide evidence to confirm this qualification when requested.

|                                                                                   |                                       |                  |
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## 4.0 TECHNICAL SPECIFICATION - MECHANICAL

### 4.1 DESIGN CRITERIA

Operation of RO Plant shall be semi-automatic through common DCS system (for UF , RO and EDI Plant). DCS system will be provided by BHEL. Bidder shall render all technical assistance in implementing the sequential operation of their system with the DCS system.

UF treated water is pumped to RO skid ( Stage-1) by Filtered feed pumps (2W + 1S). A common Antiscalant dosing system will be provided to remove the scaling tendency of water and Sodium bi-sulphite dosing system will be provided to remove the chlorine in the RO membrane feed water. A common dump valve shall be provided at high flow cartridge filter outlet at RO stage 1 (before HP pump feed). This valve shall open automatically in case any free chlorine is detected in the RO feed water through ORP measurement. 100% of the conditioned feed water from the common header is passed through RO stage -1 and the permeate water is passed through the Degasser system (excluded from bidder's scope) and is collected in the product water tank. RO stage - 1 brine water shall be terminated with a flange near the skid and further leads to the CMB (Central Monitoring Basin) through UPVC pipe line.

The permeate water from the product water tank is pumped through RO-2 feed pumps to HP pumps (2W + 1S) of RO stage-2. Final permeate from RO stage -2 is collected in RO-2 permeate water storage tank. RO stage - 2 brine water shall be led to the UF permeate water storage tank through UPVC pipe line.

A common chemical cleaning system (CIP) shall be provided to restore the membrane performance. The system shall consist of Chemical cleaning pumps (1W+1S), 1 No. of Cartridge filter housing with filter elements, Chemical cleaning tank with necessary piping, valves, drain, air vent, overflow, Man hole , ladder, controls & Instrumentations etc.

Each array (Bank-1&2) shall be cleaned individually for RO stage-1. RO stage-2, both bank-1 & 2 shall be carried out as combined. Necessary piping & valves required to achieve the above requirement shall be provided in RO skid. Necessary piping, pneumatic and manual operated valves, instruments, controls & Interlocks shall be provided in the system for semi-auto operation and also as per the Process & Instrumentation Diagram (1-WT-150-01043 Rev:00) drawing enclosed with this specification.

The details of the equipment / system are elaborated in respective section of this specification.

|                                                                                   |                                                              |                                        |
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## 4.2 TERMINAL POINTS:

- a. UF permeate water (Flow: 120 m3/hr & head: 2.0 bar) will be provided by BHEL at the inlet of high flow cartridge filters at one common point. Subsequent header piping from this point to all cart. Filter, HP pumps, RO pressure vessel are in bidder's scope.
- b. RO Stage-I permeate shall be terminated by bidder at nearby skid outlet of RO skid of stage-I with a flange & dummy flange and fasteners. Further piping to Degasser tower and to Product water Storage Tank (excluded from bidder scope) will be done by BHEL.
- c. RO-1 permeate will be provided by BHEL at the inlet of cartridge filter of RO Stage-II at one common point. Subsequent header piping from this point to all cart. Filter, HP pumps, RO pressure vessel are in bidder's scope. RO-II permeate shall be terminated by bidder at the individual skid outlet of RO skids of stage-II with a flange & dummy flange and fasteners. Further piping up to RO-2 permeate Water Storage Tank (excluded from bidder scope) will be done by BHEL.
- d. RO-1&2 brine shall be terminated at the outlet of RO skid with a flange. Further brine transfer will be in BHEL scope. RO cleaning effluent shall be terminated separately by bidder nearby skids. Further disposal/transfer will be done by BHEL.
- e. Required instrument air will be made available by BHEL at one common point of each RO skid. Bidder shall provide the necessary piping with valves for the instrument air within the skid. Bidder shall indicate the quantity of instrument air requirement in their offer.
- f. The required cleaning chemicals for cleaning of membranes will be made available by BHEL. Bidder shall provide the requirement of these chemicals/quantity in their offer for the period of six months.
- g. Power cables for all the drives will be provided by BHEL at the terminal box of respective motors. Local push button station for the respective drives will be in the scope of BHEL. Bidder shall provide the drives list in their offer.
- h. Control cables, instrument cables shall be provided by the bidder up to the junction box (junction box is in bidder scope). BHEL will provide the cables from junction box to DCS/LTMCC panel.
- i. Necessary civil works like skid foundation, trenches are excluded from bidder's scope. However bidder shall provide the details in their offer. The sizes shall be limited to the area specified in the layout drawing enclosed with this specification.

|                                                                                   |                                       |                  |
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j. All piping shall be terminated with Flange as per ANSI B 16.5, Cl. 150.

## 4.3 EQUIPMENT SPECIFICATION:

### RO STAGE -1 SKID:

#### 4.3.1 PROCESS CARTRIDGE FILTER ASSEMBLY:

- a. Equipment : Cartridge filter and accessories.
- b. Quantity : 2W + 1S
- c. Application : Micron filtration of RO feed water
- d. Operation : Continuous

### DESIGN PARAMETERS

#### a. Fluid details

- Medium handled : UF Permeate water
- pH : 6.0 - 8.0
- Temperature deg.C : 22 to 35

#### b. Operating details

- Flow m<sup>3</sup>/hr : ~120
- Design pressure bar(g) : 6 bar
- Test pressure bar(g) : 1.5 times of Design pressure
- Pressure drop Initial / Max bar(g): Bidder to specify
- Filter loading m<sup>3</sup>/hr : Max 1.0 per 10" cartridge length
- Nozzle orientation : Bidder to decide.

#### c. Construction details

##### i) **Housing assembly:**

- Vessel Type : Vertical cylindrical pressure vessel
- Vessel MOC : SS 316
- Inlet / Outlet Size & Type : Bidder to specify, Flanged
- Flange drilling standard : ANSI B16.5, 150 Class
- Vessel design : As per IS2825 or ASME Sec.VIII but need not be code stamped
- Air Vent / Drain size : Air vent – 50 NB (to meet the backwash requirement ) & bidder shall decide the drain size
- DP Connection (2 Nos) : ½" BSP Female
- Housing support : Bottom support with three legs
- External surface finish of the vessel : Mat finish

|                                                                                   |                                       |                  |
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## ii) Cartridge element

- Cartridge type : Depth type, Melt blown bonded, Disposable Polypropylene.
- End connection of cartridge : SOE, double external 222 O' rings of Filtration s.a. Code M8 or equivalent make of the manufacturer.
- Cartridge length : 40"
- Cartridge Element rating micron : 5 Nominal
- Cartridge OD / ID : inch: 2.5" / 1"

## d. Material of construction

- Shell : SS316
- Housing Cover & wetted parts : SS316
- Cartridge element : Polypropylene
- Cover seal : Buna-N 'O' ring
- Cartridge holding arrangement : SS316
- All fasteners : SS316
- Davit arrangement : SS304
- Welded parts : SS316

## e. Scope of supply per set of Cartridge filter assembly

1. Cartridge filter vessel assembly : 1 Set consists of the following
  - Cartridge filter housing : 1 No.
  - Housing cover with fasteners : 1 Set.
  - Davit arrangement : 1 No.
  - Cartridge holding arrangement : 1 Set
  - Air release valve with piping : 1 set
  - Drain valve with piping : 1 set
2. Cartridge filter elements : 1 Complete set for each vessel to suit above vessel assembly with holding arrangement.

## 4.3.2 HIGH PRESSURE PUMP WITH MOTOR (Stage I) :

- 1) Qty. : 2W + 1SB)
- 2) Operation : Continuous **with VFD**
- 3) Type : Vertical, centrifugal & multistage
- 4) MOC - Casing, Impeller& Stuffing Box: ASTM - A - 351 CF8M
  - All other wetted parts : SS 316
  - Shaft sleeve : SS 410
- 5) Location : Indoor
- 6) Speed of the pump : Not to exceed 3000 rpm
- 7) No. of stages : Bidder to decide based on the

|                                                                                   |                                               |                         |
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- |                                                           |                                                                                                                                                       |
|-----------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8) Head developed by pump                                 | functional requirement<br>: Required pressure at the end of the membrane life + friction loss (pipes, fittings & Valves)+5% margin over duty point.   |
| 9) Flow                                                   | : 120 cu.m/hr + 5% flow margin                                                                                                                        |
| 10) Impeller type                                         | : Closed                                                                                                                                              |
| 11) Bearing                                               | : Anti-friction (SKF & FAG)                                                                                                                           |
| 12) Seal                                                  | : Mechanical seal                                                                                                                                     |
| 13) Lubrication                                           | : Oil / Grease / self lubricated                                                                                                                      |
| 14) Coupling                                              | : Vendor to provide                                                                                                                                   |
| 15) Operating range                                       | : 30 – 120% of rated flow                                                                                                                             |
| 16) Pump efficiency (min.)                                | : 70%                                                                                                                                                 |
| 17) Pump characteristic                                   | : Non-overloading type & stable                                                                                                                       |
| 18) Shut-off head                                         | : About 15 % more than the rated head                                                                                                                 |
| 19) All fasteners                                         | : SS316                                                                                                                                               |
| 20) Accessories                                           | a) Instrumentation<br>b) Bolts, nuts & sleeves<br>c) Drain plug, vent, priming connection, coupling guard lifting lugs etc.<br>d) Positioning dowels. |
| 21) Motor                                                 | : As per Electrical Spec. in section 5.                                                                                                               |
| 22) Flange drilling for the pump suction discharge nozzle | : ANSI B16.5, 300 class or higher & to suit the application.                                                                                          |

**Note : HP pumps are to be selected for lowest specified temperature, for the end life of the membranes with the specified fouling factors.**

#### **4.3.3 RO STACK ASSEMBLY (MEMBRANES & PRESSURE VESSELS) – Stage I**

- |                                  |                                                                                                                        |
|----------------------------------|------------------------------------------------------------------------------------------------------------------------|
| 1) Number of skids required      | : 2-Working                                                                                                            |
| 2) Operation                     | : Continuous / intermittent                                                                                            |
| 3) Qty of raw water input        | : ~60 cu.m/hr per skid                                                                                                 |
| 4) Qty of permeate output        | : 45 cu.m/hr per skid                                                                                                  |
| 5) Type of operation             | : Continuous for 24 hours. Operation of RO plant will be automatic through DCS.                                        |
| 6) Plant recovery                | : Min.75 %                                                                                                             |
| 7) Feed water quality            | : As per enclosed specification Clause. 3.2 & 3.3                                                                      |
| 8) Quality of permeate required: | less than 80 ppm                                                                                                       |
| 9) No. of arrays (proposed)      | : 6:3 (bidder can decide for optimum performance).                                                                     |
| 10) Type of unit                 | : Completely assembled skid mounted unit with associated LP & HP piping, valves, instrumentation, etc. as per our P&ID |
| 11) Skid frame                   | : Carbon steel, with epoxy paint as Per the Painting schedule.                                                         |

|                                                                                   |                                       |                  |
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#### 4.3.4 RO MEMBRANE ELEMENTS STAGE –I :

- |                                         |                                                                                                             |
|-----------------------------------------|-------------------------------------------------------------------------------------------------------------|
| 1) No. of Streams                       | : 2 Working                                                                                                 |
| 2) Permeate output capacity per stream  | : 45 m3/hr                                                                                                  |
| 3) Size of membrane element             | : 8" dia x 40" length                                                                                       |
| 4) Area per element                     | : 400 sq.ft Max                                                                                             |
| 5) Membrane type                        | : Thin film composite polyamide with bio-fouling resistance properties.                                     |
| 6) Required plant recovery              | : 75% (min)                                                                                                 |
| 7) Feed water temperature               | }                                                                                                           |
| Design / Min / Max                      | } : 30 / 22 / 35 Deg. C                                                                                     |
| 8) RO feed pH                           | : 5 to 8                                                                                                    |
| 9) Salt rejection (min.)                | : 97.5%                                                                                                     |
| 10) Average Flux                        | : <19 l/m2/hr                                                                                               |
| 11) Lead element flux                   | : <27 l/m2/hr                                                                                               |
| 12) Flux Decline Coefficient / Year     | : Min 10%                                                                                                   |
| 13) Salt passage increase factor (SPIF) | : 10% or Bidder to specify per Year<br>(Considering the replacement rate specified below)                   |
| 14) No. of elements / vessel            | : 6                                                                                                         |
| 15) Permeate back pressure              | : 1 bar (g)                                                                                                 |
| 16) Life of membrane                    | : 3years                                                                                                    |
| 17) Membrane guarantee                  | : RO membrane shall have three years pro-rated warranty as per the membrane manufacturer's recommendations. |
| 18) Accessories required                | : Interconnectors with 'O' ring 1set per Membrane element.                                                  |
| 19) No. of elements per stream          | : Bidder to specify                                                                                         |
| 20) Supply                              | : As loose packing                                                                                          |
| 21) Membrane Assy with PV               | : Will be done at site                                                                                      |

**Note:** 1. RO membrane shall be have 3years prorated warrantee as per the membrane manufacturer's recommendations.

2. Skid assembly shall be hydro tested before dispatch in presence of BHEL/BHEL authorized agency.

|                                                                                   |                                       |                  |
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#### 4.3.5 RO PRESSURE VESSELS (Stage –I ):

- 1) Material of construction : GRP
- 2) Vessel Size : To house spiral wound RO-membranes of 8" dia, 40" length each.
- 3) No. of elements per vessel : 6
- 4) Pressure Rating : 300 psi (non coded)
- 5) Design pressure : 300 psi
- 6) Test pressure : As per ASME SEC-X / as per the design code.
- 7) Burst Pressure : As per ASME SEC-X / as per the design code.
- 8) Quantity required : Bidder to specify
- 9) Feed port :-
  - port orientation : Side port – 1no per vessel
  - port size : ~1.5" with victaulic grooves
  - MOC : SS316L
- 10) Brine port :-
  - port orientation : Side port – 1no per vessel
  - port size : ~1.5" with victaulic grooves
  - MOC : SS316L
- 11) Permeate port :-
  - port orientation : End port –2 nos per vessel
  - port size : ~1" / 1.5" (with threaded end cap on both sides)
  - MOC : Engineering thermoplastic.
- 12) Flexible coupling/equivalent to Victaulic/Piedmont:
  - Size : Vendor to decide.
  - MOC : SS316

**Note :** Adequate air vent shall be provided at feed, permeate & brine piping.



|                                                                                   |                                       |                  |
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## 4.4.0 RO STAGE -2 SKID

### 4.4.1. PROCESS CARTRIDGE FILTER ASSEMBLY:

- |                      |                                        |
|----------------------|----------------------------------------|
| a. Equipment         | : Cartridge filter and accessories.    |
| b. Quantity          | : 2W + 1 S per stream                  |
| c. Application       | : Micron filtration of RO-1 feed water |
| d. Fluid Temperature | : 22 to 35 Deg.C                       |
| e. Operation         | : Continuous                           |

#### DESIGN PARAMETERS

##### a. Fluid details

- |                  |                       |
|------------------|-----------------------|
| - Medium handled | : RO-1 permeate water |
| - pH             | : 5 to 7              |
| - Temperature    | deg.C : 22 to 35      |

##### b. Operating details

- |                               |                                                       |
|-------------------------------|-------------------------------------------------------|
| - Flow                        | m <sup>3</sup> /hr : 25                               |
| - Design pressure             | bar(g) : 6 bar                                        |
| - Test pressure               | bar(g) : 1.5 times of Design pressure                 |
| - Pressure drop Initial / Max | bar(g): Bidder to specify                             |
| - Filter loading              | m <sup>3</sup> /hr : Max 1.0 per 10" cartridge length |
| -Nozzle orientation           | : Bidder to decide.                                   |

##### c. Construction details

##### iii) **Housing assembly:**

- |                                         |                                                               |
|-----------------------------------------|---------------------------------------------------------------|
| - Vessel Type                           | : Vertical cylindrical pressure vessel                        |
| - Inlet / Outlet Size & Type            | : Bidder to specify, Flanged                                  |
| - Flange drilling standard              | : ANSI B16.5, 150 Class                                       |
| - Vessel design                         | : As per IS2825 or ASME Sec.VIII but need not be code stamped |
| - Air Vent / Drain size                 | : Air vent – 25 NB & bidder shall decide the drain size       |
| - DP Connection (2 Nos)                 | : ½" BSP Female                                               |
| - Housing support                       | : Bottom support with three legs                              |
| - External surface finish of the vessel | : Mat finish                                                  |

|                                                                                   |                                               |                         |
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**iv) Cartridge element**

- Cartridge type : Depth type, Melt blown bonded, Disposable Polypropylene.
- End connection / sealing : SOE, double external 222 O' rings of Filtration s.a. Code M8 or equivalent make of the manufacturer.
- Cartridge length : 40"
- Cartridge Element rating micron : 5 Nominal
- Cartridge OD / ID inch: 2.5" / 1"

**d. Material of construction**

- Shell : SS316
- Housing Cover & wetted parts : SS316
- Cartridge element : Polypropylene
- Cover seal : Buna-N 'O' ring
- Cartridge holding arrangement : SS316
- All fasteners : SS316
- Davit arrangement : SS304
- Welded parts : SS316

**f. Scope of supply per set of Cartridge filter assembly**

1. Cartridge filter vessel assembly : 1 Set consists of the following
  - Cartridge filter housing : 1 No.
  - Housing cover with fasteners : 1 Set.
  - Davit arrangement : 1 No.
  - Cartridge holding arrangement : 1 Set
  - Air release valve with piping : 1 set
  - Drain valve with piping : 1 set
2. Cartridge filter elements : 1 Complete set for each vessel to suit above vessel assembly with holding arrangement

**4.4.2 HIGH PRESSURE PUMP WITH MOTOR & VFD (FOR STAGE II )**

- 1) No. of Pumps : 2W + 1S
- 2) Operation : Continuous
- 3) Type : Vertical centrifugal & multi stage with VFD
- 4) MOC - Casing, Impeller& Stuffing Box: ASTM - A - 351 CF8M
  - All other wetted parts : SS 316
  - Shaft sleeve : SS 410
- 5) Location : Indoor
- 6) Speed of the pump : Not to exceed 3000 rpm

|                                                                                   |                                       |                  |
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- |                            |                                                                                                                                                         |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7) No. of stages           | : Bidder to decide based on the functional requirement                                                                                                  |
| 23) Head pumps             | : Required pressure at the end of the membrane life + friction loss(pipes, fittings & Valves)+5% over duty point                                        |
| 8) Flow                    | : 25 cu.m/hr each                                                                                                                                       |
| 9) Impeller type           | : Closed                                                                                                                                                |
| 10) Bearing                | : Anti-friction (SKF/FAG)                                                                                                                               |
| 11) Seal                   | : Mechanical seal                                                                                                                                       |
| 12) Lubrication            | : Oil / Grease / self-lubricated                                                                                                                        |
| 13) Coupling               | : Vendor to decide suitably                                                                                                                             |
| 14) Operating range        | : 30 – 120% of rated flow                                                                                                                               |
| 15) Pump efficiency (min.) | : 70%                                                                                                                                                   |
| 16) Pump characteristic    | : Non-overloading type & stable                                                                                                                         |
| 17) Shut-off head          | : About 15 % more than the rated head                                                                                                                   |
| 18) All fasteners          | : SS316                                                                                                                                                 |
| 19) Accessories            | : a) Instrumentation<br>b) Bolts, nuts & sleeves<br>c) Drain plug, vent, priming connection, coupling guard lifting lugs etc.<br>d) Positioning dowels. |
| 20) Motor                  | : As per Electrical Spec <b>ROS 4172</b>                                                                                                                |

**Note :** HP pumps are to be selected for lowest specified temperature, for the end life of the membranes with the specified fouling factors.

#### 4.4.3 RO STACK ASSEMBLY - STAGE II

- |                                  |                                                                                                                        |
|----------------------------------|------------------------------------------------------------------------------------------------------------------------|
| 1) Number of skids required      | : 2 working (no standby)                                                                                               |
| 2) Qty of raw water input        | : 12.5 cu.m/hr per skid                                                                                                |
| 3) Qty of permeate output        | : 11 cu.m/hr per skid                                                                                                  |
| 4) Type of operation             | : Continuous(24 hours)<br>plant will be automatic through DCS.                                                         |
| 5) Plant recovery                | : Min.90% for each stream                                                                                              |
| 6) Feed water quality            | : 80 ppm (Output of RO stage 1 will be the input to RO stage 2)                                                        |
| 7) Quality of permeate required: | less than 10 ppm at the end of membrane life                                                                           |
| 8) No. of arrays (proposed)      | : ~2:1 (bidder to decide)                                                                                              |
| 9) Type of unit                  | : Completely assembled skid mounted unit with associated LP & HP piping, valves, instrumentation, etc. as per our P&ID |
| 10) Skid frame                   | : Carbon steel, painted with marine grade epoxy paint as Per the Painting schedule.                                    |

|                                                                                   |                                       |                  |
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#### 4.4.4 RO MEMBRANE ELEMENTS (FOR STAGE II) :

- |                                         |                                                                                                             |
|-----------------------------------------|-------------------------------------------------------------------------------------------------------------|
| 1) No. of Streams                       | : 2 W                                                                                                       |
| 2) Permeate output capacity per stream  | : 11 m <sup>3</sup> /hr / stream                                                                            |
| 3) Size of membrane element             | : 8" dia x 40" length                                                                                       |
| 4) Area per element                     | : 400 sq.ft Max                                                                                             |
| 5) Membrane type                        | : Thin film composite polyamide                                                                             |
| 6) Required plant recovery              | : 90% (min)                                                                                                 |
| 7) Feed water temperature               | }                                                                                                           |
| Design / Min / Max                      | }                                                                                                           |
|                                         | : 30 / 25 / 35 Deg.C                                                                                        |
| 8) RO feed pH                           | : 5 to 8                                                                                                    |
| 9) Salt rejection                       | : 97.5% (min.)                                                                                              |
| 10) Average Flux                        | : <25 l/m <sup>2</sup> /hr                                                                                  |
| 11) Flux Decline Coefficient / Year     | : 5%                                                                                                        |
| 12) Salt passage increase factor (SPIF) | : 5% or Bidder to specify per Year<br>(Considering the replacement rate specified below)                    |
| 13) No. of elements / vessel            | : 6                                                                                                         |
| 14) Required array of pressure vessel   | : 2:1 (Bidder can decide for optimum performance)                                                           |
| 15) Permeate back pressure              | : 1 bar (g)                                                                                                 |
| 16) Life of membrane                    | : 3 years                                                                                                   |
| 17) Membrane guarantee                  | : RO membrane shall have three years pro-rated warranty as per the membrane manufacturer's recommendations. |
| 18) Inlet & outlet water quality        | : Refer cl. 3.2 & 3.3                                                                                       |
| 19) Accessories required                | : Interconnectors with 'O' ring 1set per Membrane element.                                                  |
| 20) No. of elements per stream          | : Bidder to specify.                                                                                        |
| 21) Supply                              | : as Loose packing                                                                                          |
| 22) Membrane Assy with PV               | : Will be done at site                                                                                      |

**Note:** 1. RO membrane shall be have 3years prorated warrantee as per the membrane manufacturer's recommendations. Warrantee will start from the date of RO commissioning.

|                                                                                   |                                                                           |                         |
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#### 4.4.5 RO PRESSURE VESSELS (FOR STAGE II ):

- 1) Material of construction : FRP
- 2) Vessel Size : To house spiral wound RO-membranes of 8" dia, 40" length each.
- 3) No. of elements per vessel : 6
- 4) Pressure Rating : 300 psi (non coded)
- 5) Design pressure : 300 psi
- 6) Test pressure : As per ASME SEC-X / as per design standard.
- 7) Burst Pressure : As per ASME SEC-X / as per design standard.
- 8) Quantity required : Bidder to specify
- 9) Feed port :-
  - port orientation : Side port – 1no per vessel
  - port size : 1.5" with victaulic grooves
  - MOC : SS316L
- 10) Brine port :-
  - port orientation : Side port – 1no per vessel
  - port size : 1.5" with victaulic grooves
  - MOC : SS316L
- 11) Permeate port :-
  - port orientation : End port –2 nos per vessel
  - port size : 1" / 1.5" (with end cap at both ends)
  - MOC : Engineering thermoplastic.
- 12) Flexible coupling/equivalent to Victaulic/Piedmont:
  - Size : Vendor to decide .
  - MOC : SS316L

|                                                                                   |                                       |                  |
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#### 4.5.0 RO CHEMICAL CLEANING SYSTEM (CIP) :

Common for both RO Sage -1 & Stage - II - contains with the following items

##### 4.5.1 CHEMICAL CLEANING TANK:

- 1) Quantity : 1 No
- 2) Type : Vertical , Cylindrical , atmospheric, with split cover
- 3) Effective Capacity : Bidder to decide (min. 5 m3)
- 4) MOC : FRP-Seamless (Bidder shall confirm the Compatibility of FRP for the respective Chemicals handled). There shall be no vertical joints (in axial direction) in the cylindrical shell. The entire thickness of the cylindrical shell shall be built up prior to removal of the shell from the mandrel.
- 5) Flange conn. for Service in/out, : Required  
recirculation, Air Vent, drain, over flow, instrumentation
- 6) Tank thickness(min) : 8 mm with corner reinforcement
- 7) Internal protection : 2.0 mm thick Vinyl Ester resin
- 8) Level indicator & level switch : Required, shall be interlocked with pump
- 9) Fasteners MOC(cover/Flange) : SS316
- 10) Necessary Electricals,C&I : To be provided
- 11) Inlet / Outlet / Recirculation Nozzles : To be provided
- 12) Over flow / drain Nozzle : To be provided
- 13) Level switches : To be provided
- 14) Level Indicator, drain valve : To be provided
- 15) Man hole, Ladder, Platform, Handrails : To be provided  
and Chemical handling arrangement

##### 4.5.2 CHEMICAL CLEANING PUMP WITH MOTOR & ACCESSORIES:

- 1) No. of Pumps : 2 Nos (1W + 1SB)
- 2) Type : Vertical / horizontal
- 3) MOC - Casing, Impeller& Stuffing Box: ASTM - A - 351 CF8M  
- All other wetted parts : SS 316  
- Shaft sleeve : SS 410
- 4) Location : Indoor

|                                                                                   |                                       |                  |
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- |                         |                                                                                                                                                                                                   |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5) Speed of the pump    | : Not to exceed 3000 rpm                                                                                                                                                                          |
| 6) Head of pumps        | : Minimum 50 mwc (or) As per system requirement at the end of membrane life for min temperature+10% margin whichever is high                                                                      |
| 7) Flow                 | : ~60 m3/hr (bidder shall decide as per the system requirement+10% )                                                                                                                              |
| 8) Impeller type        | : Closed                                                                                                                                                                                          |
| 9) Seal                 | : Mechanical seal                                                                                                                                                                                 |
| 10) Lubrication         | : Oil / Grease / self liquid (fluid cooled)                                                                                                                                                       |
| 11) Coupling            | : Flexible Spacer type                                                                                                                                                                            |
| 12) Operating range     | : 40 – 120% of rated flow                                                                                                                                                                         |
| 13) Pump characteristic | : Non-overloading type & stable                                                                                                                                                                   |
| 14) Shut-off head       | : About 15 % more than the rated head                                                                                                                                                             |
| 15) All fasteners       | : SS316                                                                                                                                                                                           |
| 16) Accessories         | : a) Instrumentation<br>b) Anchor bolts, nuts sleeves & Inserts to be embedded to concrete<br>c) Drain plug, vent, priming Connection, coupling guard lifting lugs etc.<br>d) Positioning dowels. |
| 17) Motor               | : As per Electrical Spec ( <b>ROS 4172</b> )                                                                                                                                                      |

Note: Chemical preparation tank shall be supplied as one skid and Chemical cleaning tank, pumps and cartridge filters as another skid.

#### 4.5.3 CHEMICAL CLEANING CARTRIDGE FILTER ASSEMBLY:

- |                      |                                                                               |
|----------------------|-------------------------------------------------------------------------------|
| a. Equipment         | : Cartridge filter and accessories.                                           |
| b. Quantity          | : 1 No                                                                        |
| c. Application       | : Micron filtration of Chemical cleaning solution for cleaning of RO membrane |
| d. Fluid Temperature | : 15 to 35 Deg.C                                                              |
| e. Operation         | : Intermittent                                                                |

|                                                                                   |                                       |                  |
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## DESIGN PARAMETERS

### a. Fluid details

- Medium handled : RO Chemical cleaning solution
- pH : 3 to 11
- Temperature deg.C : 22 to 35

### b. Operating details

- Flow m<sup>3</sup>/hr : ~60 (Bidder to specify)
- Design pressure bar(g) : 6
- Test pressure bar(g) : 1.5 times of Design pressure
- Pressure drop Initial / Max bar(g): Bidder to specify
- Filter loading m<sup>3</sup>/hr : Max 1.0 per 10" cartridge length
- Nozzle orientation : Side 90 deg./270deg.

### c. Construction details

#### Housing assembly:

- Vessel Type : Vertical cylindrical pressure vessel
- Inlet / Outlet Size & Type : Bidder to specify, Flanged
- Flange drilling standard : ANSI B16.5, 150 Class
- Vessel design : As per IS2825 or ASME Sec.VIII but need not be code stamped
- Air Vent / Drain size : Air vent – 50 NB (to meet the backwash Requirement also) & bidder shall decide the drain size
- DP Connection (2 Nos) : ½" BSP Female
- Housing support : Bottom support with three legs
- External surface finish of the vessel : Mat finish

#### Cartridge element

- Cartridge type : Depth type, Melt blown bonded, Disposable polypropylene
- End connection of cartridge : SOE, double external 222 O'rings of Filtration s.a. Code M8 or equivalent make of the manufacturer.
- Cartridge length : 40"
- Cartridge Element rating micron : 5 Nominal
- Cartridge OD / ID inch: 2.5" / 1"



|                                                                                   |                                       |                  |
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**d. Material of construction**

- Shell : SS316
- Housing Cover & wetted parts : SS316
- Cartridge element : Polypropylene
- Cover seal : Buna-N 'O' ring
- Cartridge holding arrangement : SS316
- All fasteners : SS316
- Davit arrangement : SS316
- Welded parts : SS316L

**g. Scope of supply per set of Cartridge filter assembly**

1. Cartridge filter vessel assembly : 1 Set consists of the following
  - Cartridge filter housing : 1 No.
  - Housing cover with fasteners : 1 Set.
  - Davit arrangement : 1 No.
  - Cartridge holding arrangement : 1 Set
2. Cartridge filter elements : 1 Complete set to suit above vessel assembly

**Note : 1.** RO skid shall be provided with approach ladder and platform for loading & unloading of the cartridge filter elements.

2. Adequate air vent shall be provided at feed, permeate & brine piping.

#### **4.6.0 GLOBE VALVES – CAGE TYPE (for each RO Stage-1 & 2)**

##### **4.6.1 GENERAL:**

- 1) Equipment : SS316 Globe Valve (Cage type)
- 2) Class : Cl. # 300
- 3) Application : For regulation purpose in RO desalination plant  
For smooth control of feed flow & pressure between the operation range as called by membrane projection, life of membrane, temperature range etc.,
- 4) Installation : Indoor
- 5) Ambient Temperature : 15 deg.C to 45 Deg.C Maximum
- 6) Operation : Continuous

##### **4.6.2 DESIGN PARAMETERS**

- 1) Fluid details
  - Medium handled : Filtered brackish water
  - pH : 3 to 11
  - Specific gravity : 1.00
  - Temperature Deg.C : 20 to 40

|                                                                                   |                                       |                  |
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2) Material of construction

- Body : SS316
- Bonnet : SS316
- Plug / Disc : SS316
- Stem / Shaft : SS316
- Seat Ring : SS316
- Cage : SS316
- Fasteners & wetted parts : SS316

#### 4.6.3 DESIGN DETAILS:

##### A. FEED CONTROL VALVE (FCV) (RO Stage-1 & 2)

- 1) Purpose : To regulate the feed pressure in the RO plant.
- 2) Type : Cage type
- 3) Valve size : Bidder to decide
- 4) End connection : Flanged , ANSI B 16.5, 300 Class  
(Bidder to confirm)
- 5) Pressure drop at full opening : Minimum possible

##### RO Stage - 2

- 6) Max. feed TDS / Cl : Bidder to decide
- 7) Rated flow Cu.m/hr : 120 & 25 for RO stage-1 & 2 respectively
- 8) Operating Pressure Norma/Max : Bidder to decide
- 9) Nominal pipe size : Bidder to decide

**NOTE:** Bidder to select the valves suitable for downward pressure regulation of 10 bar from the operating pressure by manual adjustment and also indicate the % of lift for above adjustment.

##### B. BRINE CONTROL VALVE (BCV)

- 1) Purpose : To control & Create back pressure in the RO Desalination plant
  - 2) Valve size : Bidder to decide
  - 3) End connection : Flanged, ANSI B 16.5, 150 or 300 Class  
(Bidder to confirm)
  - 4) Pressure drop at full opening : Minimum possible
- |                                 | <b>RO Stage – 1</b> | <b>RO Stage - 2</b> |
|---------------------------------|---------------------|---------------------|
| 5) Max. Brine TDS / Cl          | : Bidder to decide  | Bidder to decide    |
| 6) Rated flow Cu.m/hr           | : 25.0              | 3.0                 |
| 7) Operating Pressure Norma/Max | : Bidder to decide  | Bidder to decide    |
| 8) Nominal pipe size            | : Bidder to decide  | Bidder to decide    |

**NOTE:** Bidder to select the valves suitable for downward pressure regulation nearing to atmospheric pressure from the operating pressure by manual adjustment.

|                                                                                   |                                       |                  |
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#### 4.7.0 SILENT CHECK VALVE (NON-SLAM) :

- |                        |                                     |
|------------------------|-------------------------------------|
| 1) Equipment           | : SS316 Silent Check (non-Slam)     |
| 2) Class               | : Cl.# 300                          |
| 3) Mounting Type       | : Flange                            |
| 4) Valve size          | : bidder to decide                  |
| 5) MOC                 | : SS316                             |
| 6) Ambient Temperature | : 15 -45 Deg. C                     |
| 7) Application         | : To arrest back flow to RO HP Pump |
| 8) Operation           | : Continuous                        |

#### 4.8.0 GENERAL DESIGN REQUIREMENTS

The common requirements for the system are stated in the general design requirements of this section 4.4. However the requirements indicated in the specification for mechanical equipment section 4.3.1 to 4.3.5 shall be strictly complied with.

1. The RO stage-1 SKIDs shall be a completely assembled skid mounted units including the components mentioned in cl. 4.3.3, to 4.3.5 with associated LP & HP piping, valves, instrumentation, etc, as per our P & ID enclosed with this specification
2. The RO stage-2 SKIDs shall be a completely assembled skid mounted units including the components mentioned in cl. 4.4.3 to 4.4.5 with associated LP & HP piping, valves, instrumentation, etc, as per our P & ID enclosed with this specification
3. Adequate air vent shall be provided at feed, permeate & brine piping.

#### 4.8.1 COMMON REQUIREMENTS FOR ALL SYSTEM:

1. All the rotating equipments noise level shall be < 85db measured at 1 mtr distance from the equipment.
2. Only latest revision of standard shall be used.
3. Sampling connections and air vent at the top most point of piping and vessels shall be provided at all stages of the Unit.
4. All the valves are to be located to facilitate easy accessibility and operation from the ground level.
5. All fasteners shall be of SS 316.
6. Bidder shall follow the Bidder list (approved by the Customer) only for all their equipment, sub-systems and components.
7. Customer's inspection at Bidder's works is applicable for specified components as per the approved QP /spec.
8. All UPVC pipe lines (piping, fittings, & valves) shall be Georg Fisher, FIP & Astral.

|                                                                                   |                                                                           |                         |
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9. Bidder shall submit detailed process calculations and major system drawings for the approval of BHEL's Customer. These documents require approval of the Customer before commencement of the work.

#### 4.8.2 CENTRIFUGAL PUMPS:

1. The maximum efficiency of the pumps shall be preferably within +5% of the rated design flow indicated in the data sheet.
2. Total head capacity curve shall be continuously rising from the operating point towards shut-off without any zone of instability and with a minimum shut off head of 15 % more than design head.
3. Pumps of a particular category shall be identical and shall be suitable for parallel operation with equal load division.
4. Components of identical pumps shall be interchangeable.
5. The noise level shall not exceed 85dBA at a distance of 1m from the equipment.
6. The pump shall be capable of starting with discharge valve fully open and close condition
7. Continuous motor rating at 50 deg.C ambient shall be at least 10% above the maximum load demand of the pump in the entire operating range to take care of the system frequency variation.
8. The critical speed of the pumps shall be well away from the operating speed and in no case less than 130% of the rated speed.
9. Tolerance on pump guaranteed efficiency and rated head for the rated flow shall be plus or minus 3%.
10. Pressure gauges shall be provided on discharge side of all pumps.(excluded)
11. Each pump suction and discharge shall be installed with an expansion bellow.
12. The pumps shall be controlled from remote panel and locally.

#### 4.9.0 PIPING

##### 4.9.1 LINE SIZING

1. Sizes of pipelines shall be selected such that the velocity of fluid in pipes does not exceed the following limits under conditions of maximum possible volumetric flow:
  - Pump Suction : < 1.2 m/sec
  - Pump Discharge & re-circulation : 1.5 to 2.5 m/sec for UPVC & MSRL  
Pipe line.
  - : < 2.5 m/Sec for SS316  
Pipe line
  - High pressure pump discharge : < 3.5 m/sec
  - Service water / Potable water : 1.5 m/sec
  - Compressed air : 6 m/Sec
2. Corrosion allowance of 1.6mm shall be added to the calculated thickness.

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3. All high points in piping system shall be provided with vents along with valves.  
All low points shall be provided with drains along with valves.
4. Compressed air pipe work shall be adequately drained to prevent internal moisture accumulation and moisture traps shall be provided at strategic location in piping system.
5. Supporting arrangement of piping system shall be properly designed for systems where hydraulic socks and pressure surges may arise in the system during operation
6. Overhead piping shall have a normal minimum vertical clearance of 2.5 mtrs above walkways and working areas and 8mtrs above roadways / railways.
7. Sufficient up stream and down stream lengths shall be provided for flow measuring device, control valves and other specialties.
8. Materials:
  - All materials shall be new and procured preferably from the manufacturer.
  - Test certificate / compliance certificate to be furnished by the bidder for all the components instruments & piping etc.

#### 4.9.2 MATERIALS OF CONSTRUCTION:

| SL. NO.    | SERVICE                                                                                                               | SIZE         | PIPES                                   | FITTINGS                                                    | FLANGES                                                   | GASKETS                | LINE JOINT                 |
|------------|-----------------------------------------------------------------------------------------------------------------------|--------------|-----------------------------------------|-------------------------------------------------------------|-----------------------------------------------------------|------------------------|----------------------------|
| <b>1.0</b> | <b>Low Pressure Application</b>                                                                                       |              |                                         |                                                             |                                                           |                        |                            |
| <b>1.1</b> | UF permeate water, Degassed water, Service water, treated effluent disposal, RO Permeate, Chemical Cleaning, rinsing, | Upto DN 200  | UPVC , PN10 as per latest DIN standard  | UPVC , PN10 as per latest DIN standard                      | UPGF / PP Flange drilling should be ANSI B16.5, 150 Class | Neoprene rubber gasket | Solvent cemented / flanged |
|            |                                                                                                                       | Above DN 200 | SS 316L                                 | SS 316L                                                     | SS 316                                                    | EPDM rubber gasket     | Flange/ insitu joint       |
| <b>1.2</b> | Instrument Air & Plant Air line                                                                                       | All sizes    | Galvanised as per IS 1239 , Heavy grade | Screwed fittings of Galvanised as per IS 1239 , Heavy grade | Not applicable. Screwed fitting shall be considered       | Not applicable         | Screwed connections        |
| <b>2.0</b> | <b>High Pressure Application</b>                                                                                      |              |                                         |                                                             |                                                           |                        |                            |
| <b>2.1</b> | High Pressure Lines                                                                                                   | All sizes    | ASTM A-312 TP 316L - ERW, SCH40         | ASTM A182F 316L Butt welded fittings, SCH40                 | Socket welded, as per ANSI B16.5, 150 Class               | Neoprene rubber gasket | Butt welded                |

|                                                                                   |                                                                           |                         |
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## Notes

1. Pipes shall be tested for its material composition and certificate shall be enclosed for the same.
2. All branch connections shall be wrought or forged steel based on the size and availability based on ASTM Standards.
3. All piping & valves supports shall be of dismantling type for easy maintenance using suitable bolted connections.
4. For LP piping: UPVC up to DN 200 and SS 316 for size above DN 200.

## 4.10. VALVES

### 4.10.1 DESIGN AND CONSTRUCTION FEATURES

The following consideration shall be made during the design / selection of valves for the RO System.

1. For the RO system, Butterfly valves and diaphragm type valves shall be used for isolation / regulation purpose.
2. Bidder to select suitable material of construction for the valves based on the system requirement as per clause 4.6.2.
3. The end connection for the diaphragm valves shall be of flanged type as per ANSI B16.5, 150 class.
4. Pressure rating of valves shall be of minimum PN10
5. Necessary pneumatic actuated valves shall be provided for auto operation & Chemical cleaning of the plant as per the P & I diagram.
6. The painting shall be as per the requirements indicated in the painting specification.
7. In the HP pump discharge a silent (non-slam) check valves with single disc wafer type shall be installed.
8. Butterfly valves shall be of wafer type suitable for mounting between flanges.
9. The Material of Construction of the body and disc of check valve shall be SS 316.
10. Bidder shall furnish the valves schedule in the attached format. (Annexure - 4)
11. Cast steel valves shall be provided for compressed air system.
12. Ball valves or Plug valves shall be provided for oil and air system.

|                                                                                   |                                               |                          |
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#### 4.10.2 VALVE – MATERIALS

| Sl. No. | Service                                             | Valve Type            | Size   | BODY                                                | Disc / Ball / Diaphragm    | Stem / Shaft               | Valve seat / Seat ring | Hinge Pin | Valve Ends                 |
|---------|-----------------------------------------------------|-----------------------|--------|-----------------------------------------------------|----------------------------|----------------------------|------------------------|-----------|----------------------------|
| 1       | UF permeate water, Degassed water and Service water | UPVC Ball Valve       | ≤50 NB | UPVC                                                | UPVC                       | UPVC                       | PTFE                   | ---       | Solvent cement Socket End  |
|         |                                                     | UPVC Ball Check Valve | ≤50 NB | UPVC                                                | UPVC                       | ---                        | EPDM                   | ---       | Solvent cement Socket End  |
|         |                                                     | Butterfly Valve       | ≥65NB  | CI                                                  | SS316                      | SS316                      | EPDM                   | ---       | Lugged /Wafer Construction |
|         |                                                     | Check Valve           | ≥65NB  | ASTM A 351, Gr.CF 8M /                              | ASTM A 351, Gr.CF8M        | Stainless Steel            | Stainless Steel        | AISI 316  | Lugged/ Wafer Construction |
| 2       | Non slam silent check valve                         | Wafer type            | ≥65 NB | SS316                                               | SS316                      | SS316                      | EPDM                   |           | Wafer type                 |
| 3       | Chemical dosing Line                                | UPVC Ball Valve       | ≤50 NB | UPVC                                                | UPVC                       | UPVC                       | PTFE                   | ---       | Solvent cement Socket End  |
| 4       | Chemical Cleaning Line                              | UPVC Ball Valve       | ≤50 NB | UPVC                                                | UPVC                       | UPVC                       | PTFE                   | ---       | Solvent cement Socket End  |
|         |                                                     | Butterfly Valve       | ≥65NB  | CS                                                  | ASTM A 351, Gr.CF8M        | SS316                      | EPDM                   | ---       | Lugged /Wafer Construction |
|         |                                                     | Check Valve           | ≥65NB  | ASTM A 351, Gr.CF 8M /                              | ASTM A 351, Gr.CF8M        | Stainless Steel            | Stainless Steel        | AISI 316  | Lugged/ Wafer Construction |
| 5       | Compressed air application                          | Ball Valve            | ≤50 NB | Galvanized cast carbon steel or Forged carbon steel | Stainless Steel / ANSI 420 | Stainless Steel / ANSI 420 | Nitrile Rubber / PTFE  | ---       | Flanged End                |

#### Notes

1. Valves : UPVC up to DN 50, CI body with SS 316 disc for size above DN 50

|                                                                                   |                                       |                   |
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#### 4.11.0 PAINTING

All the Equipment and steel structures shall be protected against external and internal (if any) corrosion by providing suitable painting as described below unless otherwise specified elsewhere. However, the surfaces of stainless steel, Galvanised steel, Gunmetal, brass, bronze, UPVC pipes, HDPE pipes and non-metallic components shall not be applied with any painting.

All painting shall be carried out in conformity with the paint manufacturer's recommendation.

##### a. SCOPE

This section covers the painting requirements for skids, equipment & Accessories.

##### b. CODES AND STANDARDS

Painting of equipment shall be carried out as per the specifications indicated below and shall conform to the relevant IS specification for the material and workmanship.

IS: 5 : Colours for ready mixed paints and enamels  
IS: 1303 : Glossary of terms relating to paints  
IS: 9954 : Surface Preparation standard for painting of Steel surfaces.

##### c. PREPARATION OF SURFACES

All surfaces to be painted shall be thoroughly cleaned of all grease, oil, loose mill scale, dust, rust and any other foreign matter. Mechanical cleaning by power tool and scrapping with steel wire brushes shall be adopted to clear the surfaces. However, in certain locations where power tool cleaning cannot be carried out; sand scrapping may be permitted with steel wire brushes and/or abrasive paper. Cleaning with solvents shall be resorted to only in such areas where other methods specified above have not achieved the desired results. Cleaning with solvents shall be adopted only after written approval of the OWNER / ENGINEER.

##### d. PRIMER PAINT

After the surface is prepared, one coat of Zinc phosphate epoxy primer shall be applied. After this first coat is dried up completely, second coat shall be applied. Primer shall be applied by brushing to ensure a continuous film without 'holidays'. The total dry film thickness of shall be minimum 100 microns.

##### e. INTERMEDIATE COAT PAINT

After the primer coat, one intermediate coat of Micaceous Iron Oxide / Titanium dioxide shall be applied. The dry film thickness shall be minimum 150 microns.



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**f. FINISH PAINT**

One layer of Polyester Urethane, shall be used for finish coat. The colour/shade shall be as approved by the OWNER. Dry film thickness of 50 microns.  
The total system DFT after finish painting shall be minimum 300 microns.

g. **SUGGESTED COLOUR CODES FOR PAINTING:** IS-5, shade 631, Light Grey.

**4.12.0 PACKING:**

Being export Order Sea worthy packing shall be done to meet the requirement. For further details, please refer attached specification No. PE-TS-888-100-A001, Vol II B, section D.

**4.13.0 SUB- VENDOR LIST FOR RO SYSTEM**

Please refer to the enclosed sub-vendor list **Annexure- I**

**5.0 TECHNICAL SPECIFICATION FOR ELECTRICAL, CONTROLS & INSTRUMENTATION**

Electrical, Controls & Instrumentation requirements for the RO system is attached separately along with this specification. **ROS: 4172**

**6.0 TECHNICAL DETAILS FOR CIVIL WORKS:**

Construction of civil building, foundation and flooring etc for the RO system is not in bidder scope. However the bidder shall provide the equipment layout drawing along with bid. The approximate area of the RO building is indicated in the enclosed preliminary drawing. Detailed construction drawing with foundation requirement like load details, foundation pockets etc, for all the equipments including tanks, flooring requirements, trenches for pipe routing, cable routing & drains etc. shall be furnished to BHEL for further construction immediately after order. Any special requirement like handling arrangement, floor / trench protection etc. shall also be indicated in the drawings. All the plant drains & trenches are to be connected in a common trench and terminated near RO Plant boundary. Foundation bolts, nuts & washers for all equipments supplied by the bidder are in their scope.

|                                                                                   |                                                                           |                          |
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## 7.0 PERFORMANCE GUARANTEE

The system performance guarantees applicable are detailed in this section.

In addition to the guarantees mentioned in earlier clause, the requirements of specifications on all guarantees as elaborated under relevant clauses of Technical Specifications should be met.

The guarantee for the equipment shall start after 18 months from the date of supply (or) 12 months from the date of commissioning, whichever is earlier.

Any part which proves defective either in design, materials / and / or manufacture within the above guarantee period shall be replaced at free of cost to the owner at site and the provision of this clause shall apply to the portions of the plant so replaced or renewed until the expiration of the guarantee period or from the date of replacement whichever is later.

### 7.1 PERFORMANCE GUARANTEE TEST

The bidder shall guarantee all equipment's for workmanship, materials and satisfactory performance. The guarantee for performance will cover individual items and systems including electrical for their ratings / outputs as well as for the integrated operation of equipment and its auxiliaries as a whole.

On completion of satisfactory commissioning, the supplier shall conduct performance / acceptance tests on the equipment and system as a whole for demonstrating the guaranteed performance parameters specified. All instruments, gauges installed for the normal operation of equipment shall, be made use of during the acceptance test as far as possible. If additional instruments are required for the tests, these shall be brought by supplier free of cost and shall be taken back after performance test.

The guarantee tests shall cover the following but not limited to the rated parameters for smooth operation of complete RO system:

- a. RO Permeate water quality as per enclosed specification clause 3.3
- b. RO system net output and recovery
- c. Power consumption for continuous operating equipment as per Annexure-2
- d. Vibration and noise level of rotating equipment.

### 7.2 Duration of PG test shall be as per the approved PG test procedure by the customer. performance test run shall be conducted for the guaranteed values of treated water quality, quantity and other performance parameters.

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### 7.3 PERFORMANCE BANK GUARANTEE (PBG):

The successful bidder will have to provide a BG of **10 %** of the contract value for overall performance of the plant until the expiry of the guarantee period.

## 8.0 SPARES

### 8.1 Commissioning spares:

The bidder shall provide commissioning spares and the commissioning spares shall be delivered along with main supply. The commissioning spares list is indicated in this section. Over and above any additional requirements for trouble free commissioning of the equipment / system shall be included in the list. The price for the commissioning spares shall be included in the main supply and the list shall be provided along with the bid, this price will be included for bid evaluation.

#### 8.1.1 Cartridge filters:

| Sl. No | Spares Description | Type of spare                         | Qty. | Unit |
|--------|--------------------|---------------------------------------|------|------|
| 1      | Cartridge filters  | Cartridge filter elements             | 02   | sets |
| 2      | Cartridge filters  | Gaskets for each type of Cart. Filter | 1    | Set  |

#### 8.1.2 RO MEMBRANE:

| Sl. No | Spares Description | Type of spare          | Qty. | Unit |
|--------|--------------------|------------------------|------|------|
| 1      | Inter connector    | Connector With O-rings | 10   | sets |

#### 8.1.3 INSTRUMENTS :

| Sl. No | Spares Description | Type of spare                | Qty. | Unit |
|--------|--------------------|------------------------------|------|------|
| 1      | ORP Analyzer       | Complete set of ORP Analyzer | 1    | set  |

|                                                                                   |                                                                           |                          |
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## 8.2.0 Mandatory Spares

The price for the mandatory spares shall be given separately and shall not be included in the main supply. The list of the mandatory spares is as given below. Mandatory spares shall be packed separately with detailed packing list (items should not be packed along with main supply items)

All spares supplied under this Contract shall be strictly interchangeable with the parts for which they are intended for replacements. The spares shall be treated and packed for long storage under the climatic conditions prevailing at site e.g small item shall be packed in sealed transparent plastic bags with desiccator packs as necessary.

Each spare shall be clearly marked or labelled on the outside of the packing with its description. When more than one spare part is packaged in a single case, a general description of the contents shall be shown on the outside of such case and a detailed list should be enclosed. All cases, containers and other packages must be suitably marked and numbered for the purpose of identification.

Bidder to quote for the following mandatory spares.

### (a). Mechanical

| Sl. No | Spares Description            | Type of spare             | Qty                                 | Unit |
|--------|-------------------------------|---------------------------|-------------------------------------|------|
| 1      | Cartridge Filters             | Cartridge filter elements | 10% of the total installed elements |      |
| 2      | RO High Pressure Pump Stage-1 | <b>If vertical pump</b>   |                                     |      |
|        |                               | Shaft sleeves             | 1                                   | set  |
|        |                               | Bearing                   | 1                                   | set  |
|        |                               | Wear rings                | 1                                   | set  |
|        |                               | Impeller                  | 1                                   | set  |
|        |                               | Complete shaft            | 1                                   | set  |
|        |                               | Shaft sleeve              | 1                                   | set  |
|        |                               | Packing                   | 1                                   | set  |
|        |                               | Mechanical seal           | 1                                   | set  |
|        |                               | Seals                     | 1                                   | set  |
|        |                               | Fasteners                 | 1                                   | set  |

|                                                                                   |                                               |                   |
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|   |                                  |                                  |   |     |
|---|----------------------------------|----------------------------------|---|-----|
|   |                                  | Couplings                        | 1 | set |
|   |                                  | Bushes                           | 1 | set |
|   |                                  | All gaskets                      | 1 | set |
|   |                                  | “O” rings                        | 1 | set |
|   |                                  | Impeller nut                     | 1 | set |
|   |                                  |                                  |   |     |
|   | RO High Pressure Pump Stage-I    | <b>If horizontal pump</b>        |   |     |
|   |                                  | Shaft sleeves                    | 2 | set |
|   |                                  | Casing wear ring                 | 2 | set |
|   |                                  | Pump bearing                     | 2 | set |
|   |                                  | Fasteners                        | 1 | set |
|   |                                  | Complete coupling (pump & motor) | 1 | set |
|   |                                  | Mechanical seal                  | 1 | set |
|   |                                  |                                  |   |     |
| 3 | RO High Pressure Pump Stage - II | <b>If vertical pump</b>          |   |     |
|   |                                  | Shaft sleeves                    | 1 | set |
|   |                                  | Bearing                          | 1 | set |
|   |                                  | Wear rings                       | 1 | set |
|   |                                  | Impeller                         | 1 | set |
|   |                                  | Complete shaft                   | 1 | set |
|   |                                  | Shaft sleeve                     | 1 | set |
|   |                                  | Packing                          | 1 | set |
|   |                                  | Mechanical seal                  | 1 | set |
|   |                                  | Seals                            | 1 | set |
|   |                                  | Fasteners                        | 1 | set |
|   |                                  | Couplings                        | 1 | set |
|   |                                  | Bushes                           | 1 | set |
|   |                                  | All gaskets                      | 1 | set |
|   |                                  | “O” rings                        | 1 | set |
|   |                                  | Impeller nut                     | 1 | set |
|   |                                  |                                  |   |     |
|   |                                  |                                  |   |     |

|                                                                                   |                                               |                   |
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|   |                                 |                                                       |                                 |     |
|---|---------------------------------|-------------------------------------------------------|---------------------------------|-----|
|   | RO High Pressure Pump Stage -II | <b>If horizontal pump</b>                             |                                 |     |
|   |                                 | Shaft sleeves                                         | 2                               | set |
|   |                                 | Casing wear ring                                      | 2                               | set |
|   |                                 | Pump bearing                                          | 2                               | set |
|   |                                 | Fasteners                                             | 1                               | set |
|   |                                 | Complete coupling (pump & motor)                      | 1                               | set |
|   |                                 | Mechanical seal                                       | 1                               | set |
|   |                                 |                                                       |                                 |     |
| 4 | RO Membranes Stage – I (PWTS)   | RO membrane                                           | 10% of total installed membrane |     |
| 5 | RO pressure vessel              | Rupture disc /End plate assy.                         | 20                              | Nos |
| 6 | RO Membranes Stage – II (PWTS)  | RO membrane                                           | 10% of total installed quantity |     |
| 7 | RO CIP Pump                     | Shaft sleeves                                         | 2                               | set |
|   |                                 | Casing wear ring                                      | 2                               | set |
|   |                                 | Pump bearing                                          | 2                               | set |
|   |                                 | Fasteners                                             | 1                               | set |
|   |                                 | Complete coupling (pump & motor)                      | 1                               | set |
|   |                                 | Mechanical seal                                       | 1                               | set |
| 8 | Complete Globe valve            | 10% of population of each type & size with min. 1 no. |                                 |     |
|   | Disc (Globe valve)              | 10% of population of each type & size with min. 1 no. |                                 |     |
|   | Stem (Globe valve)              | 10% of population of each type & size with min. 1 no. |                                 |     |
|   | Seal ring                       | 10% of population of each type & size with min. 1 no. |                                 |     |
|   | Gasket                          | 10% of population of each type & size with min. 1 no. |                                 |     |
|   | Yoke bush                       | 10% of population of each type & size with min. 1 no. |                                 |     |
|   |                                 |                                                       |                                 |     |

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|    |                               |                                                       |
|----|-------------------------------|-------------------------------------------------------|
| 9  | Butterfly valve               | 10% of population of each type & size with min. 1 no. |
|    | Reduction gear operator (BFV) | 10% of population of each type & size with min. 1 no. |
|    | Disc (BFV valve)              | 10% of population of each type & size with min. 1 no. |
|    | Stem (BFV)                    | 10% of population of each type & size with min. 1 no. |
|    | Seal ring                     | 10% of population of each type & size with min. 1 no. |
|    | Bearing (BFV)                 | 10% of population of each type & size with min. 1 no. |
|    | Gasket                        | 10% of population of each type & size with min. 1 no. |
| 10 | Check valve                   | 10% of population of each type & size with min. 1 no. |
|    | Flap/Door with pin (NRV)      | 10% of population of each type & size with min. 1 no. |
|    | Flap rings (NRV)              | 10% of population of each type & size with min. 1 no. |
|    |                               |                                                       |

(b). Electrical

| Sl. No | Spares Description                    | Unit | Quantity/set |
|--------|---------------------------------------|------|--------------|
| a)     | Motor for RO stage-1 HP pump (PWTS)   | No   | 01           |
| b)     | Bearing for RO stage-1 HP pump (PWTS) | Set  | 01           |
| c)     | Motor for RO stage-2 HP pump (PWTS)   | No   | 01           |
| d)     | Bearing for RO stage-2 HP pump (PWTS) | Set  | 01           |
| e)     | Motor for RO CIP pump                 | No   | 01           |
| f)     | Bearing for RO CIP motor              | Set  | 01           |

|                                                                                   |                                               |                          |
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(c). Instruments

| S. No | Item Description                                    | Quantity / Unit                                                                         |
|-------|-----------------------------------------------------|-----------------------------------------------------------------------------------------|
| 1     | <b>CONTROL &amp; INSTRUMENTATION</b>                |                                                                                         |
| 1.1   | Local gauges (pressure, temperature, level, flow)   | 10% for each type and range subject to minimum 2 nos.                                   |
| 1.11  | Solenoid valve                                      | 10% for each type and size subject to minimum 2 nos.                                    |
| 1.12  | Flow meters                                         | Accessories (as recommended by the manufacturer) - minimum 2 nos in each type and size. |
| 1.13  | Transmitters (Pressure, temperature, Flow, level)   | 10% for each type and range subject to minimum 2 nos.                                   |
| 1.14  | Field switches                                      | 10% for each type and range subject to minimum 2 nos.                                   |
| 1.15  | Temperature elements and thermo wells               | 10% for each type, range and pipe size subject to minimum 2 nos.                        |
| 1.16  | SMART positioner                                    | Accessories as per manufacturer recommendation.                                         |
| 1.17  | Air filter regulator                                | 10% for each type and range subject to minimum 2 nos.                                   |
| 1.18  | Limit switches/Torque switches                      | 10% for each type and range subject to minimum 2 nos.                                   |
| 1.19  | Gaskets/Washers / O-Rings (for each size and type)  | 10% for each type and range subject to minimum 2 nos.                                   |
| 1.2   | Conductivity probes                                 | 10% for each type and range subject to minimum 2 nos.                                   |
| 1.21  | Indicators and Electrical metering instruments      | 10% for each type and range subject to minimum 2 nos.                                   |
| 1.22  | Junction boxes (Terminal blocks, cable glands, lug) | 10% for each type and range subject to minimum 2 nos.                                   |
| 1.23  | Terminal blocks, fuses, MCB's for VFD panel         | 10% for each type and size subject to minimum 2 nos.                                    |

Note: 1. For Instrument mandatory spares refer E C&I technical specification **ROS:4172**  
2. **For ETP RO mandatory spares refer ROS:6170/Rev.00**



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### 8.3.0 Recommended Spares for 2 years O & M :

Bidder also provide the list of recommended spares for two years of normal operation of the plant over & above the mandatory spares. The bidder shall provide the list of recommended & to be filled as per **Annexure-5**

BHEL reserves the right to finalize the exact quantity of recommended spares parts and effect price adjustment on basis of unit rates quoted by the bidders.

The price of recommended spares **will not be considered for bid evaluation.**

The prices of recommended spares shall be consistent with those of the mandatory spares. The validity of prices for these spares shall be up to 2 years.

### 9.0.0 Inspection

Inspection by BHEL corporate Quality. Vendor shall submit the QAP for the Customer approval before start-up of the manufacturing.

Manufacturing quality plan shall detail out, for all the components and equipment, various tests/inspection to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by contractor's quality control organization, the relevant reference document and standards, acceptance norms and inspection documents raised etc. during all stages of material procurement, manufacture, assembly and final testing/performance testing.

No materials/equipment shall be dispatched from the manufacturer's works before the same is either accepted subsequent to pre-dispatch final inspection including verification of records of all previous tests/inspections by purchaser's Engineer /authorized representatives, or such pre-dispatch final inspection is waived by the purchaser and dispatch is authorized after review of test reports.

### 10.0 ERECTION, COMMISSIONING & PG TEST:

Erection, commissioning, PG test & Handing over for the RO system shall be as per the requirement mentioned elsewhere in the specification

Successful bidder has to manufacture the equipment as per approved drawing and despatch the materials sequentially required for erection of the RO system. These items shall be transported to site as per purchase instructions. BHEL will receive the materials and store them as received. Bidder shall provide the details of storage procedure & required space well in advance.

|                                                                                   |                                                                     |                                 |
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The successful commissioning means, erection of entire system, trial run/trial operation till achieving the performance both in terms of quality (including electrical power consumption) and quantity to prove the agreed performance of the system /equipment and it is ready for PG test.

Technical assistance for maximum of fifteen days (comprising two visits & excluding travels and holidays) at Kilwa site for erection stage clearance, commissioning, post commissioning/PG test. Vendor to include travel to & fro charges, lodging, local conveyance etc., for the above.

Vendor to give optional price for additional visit (one visit consist of minimum three days) which include travel to & fro charges, lodging, local conveyance etc. Also vendor to provide break-up price for the additional visit.

Payments will be made for the actual services utilized at site

## **11.0 DOCUMENTATION:**

The documentation during bid and post order stage shall meet the following requirements.

1. All documents and drawing shall be submitted in English
2. Hard copies of all documents and drawings during bid stage to be submitted in duplicate.
3. Hard copies of all documents for approval shall be submitted in triplicate.
4. Hard copies of all final documents, drawings, manual etc., shall be submitted in bound folder in duplicate.
5. Soft copies of all final documents in MS word / MS office in the form of CD –1 set
6. Soft copies of all final calculations in MS excel/ MS officer in the form of CD–1set
7. Soft copies of all final drawings in Auto Cad, latest version in the form of CD-1set

## **11.1 GUARANTEE DOCUMENTS**

Bidder shall provide the following guarantee documents along with the bid. Otherwise the offer will be considered as incomplete.

1. RO permeate water quality & Quantity as per Annexure - 1
2. RO Membrane guarantee as per enclosed sample format .
3. Guaranteed power Consumption for normal, continuous operating equipment as per Annexure – 2

|                                                                                   |                                       |                   |
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## 11.2 DOCUMENTS ALONG WITH BID:

The following drawings / documents are to be enclosed along with the bid for scrutiny.

1. Technical write-up giving details of equipment operation, interlocks / control requirement.
2. RO membrane projections (end of 3rd year at 22c, 30 c and 35c).
3. Membrane Datasheet.
4. Preliminary P&I diagram
5. Preliminary skid drawing
6. Filled up data sheets as called in the specification – **Annexure -3 to 5**
7. Utility requirements like instrument air, Electric load requirement.
8. Details called in E, C & I specification.
9. Deviation schedule duly filled, if any –**Annexure – 6**. Any deviation should have cost of withdrawal for our evaluation in the commercial bid.
10. Typical Quality Plan.
11. Un priced commercial offer on the scope of supply
12. Un priced commercial offer for the recommended spares list

### Note:

In case of any deviation, the Bidder shall indicate the deviation, clause by clause in the deviation format attached in **Annexure - 6**. If there is no deviation “NIL” statement shall be furnished. In the absence of the non attachment of this **Annexure-6**, it will be construed that the bid confirms strictly to the specification.

## 11.3 DOCUMENTS AFTER ORDER

The following documents/Drawings and data to be furnished for BHEL / customer approval/information

### Phase-I (for approval) within 3 weeks days from the date of LOI:

1. Technical Write-up and design basis
2. Process Flow Diagram
3. P&ID diagram including pipe sizes & terminal points.
4. Layout showing building details, headroom, equipment.
5. Preliminary GA drawings of the equipment
6. Preliminary Foundation details for the supplied equipment's
7. RO Membrane projections
8. Filled up datasheets for approval as per **Annexure – 2**
9. Preliminary electrical load list

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10. RO system “Control Description” write-up including operation, controls, interlocks, protection, annunciation etc.

**Phase-II (for approval) within 5 weeks from the date of LOI:**

1. Detailed construction and cross-sectional drawings of skids and 3D plant.
2. Detailed assembly & cross sectional drawings for pumps and motor with bill of materials.
3. Pumps performance curves
4. Foundation Design details/drawings indicating foundation load data, anchor bolt location, pocket details, floor & trenches etc.
5. Quality Plan and field quality checks, stage inspection etc. for the above equipment & system
6. RO Membrane Guarantee Document.
7. Duly filled data sheets enclosed as per annexure 3-5
8. Instrument schedule.
9. DCS I/O list.

**Phase-III For information & Review (within 8 weeks from the date of LOI):**

1. RO membrane storage procedure before commissioning
2. RO membrane preservation procedure after commissioning
3. Piping and Valves schedule
4. Bidder shall provide necessary erection drawings (isometric piping, drawings for pipe supports etc.) for the requirement under bidder scope.
5. As-built manufacturing drawing of the RO skids frame and equipment, assembly including piping & valve system arrangements with Bill of material (BOM)
6. Isometric drawing of pipe segments.
7. Details of pneumatic actuators
8. Erection Manual indicating
  - a. Erection/installation instructions of equipments.
  - b. Log sheet containing stage check parameters & clearance
  - c. Log sheets for alignment check of pump & motor
  - d. Field quality checks
9. Performance Test procedure
10. All the documents called in Electrical specification.

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#### **Phase-IV (for review):**

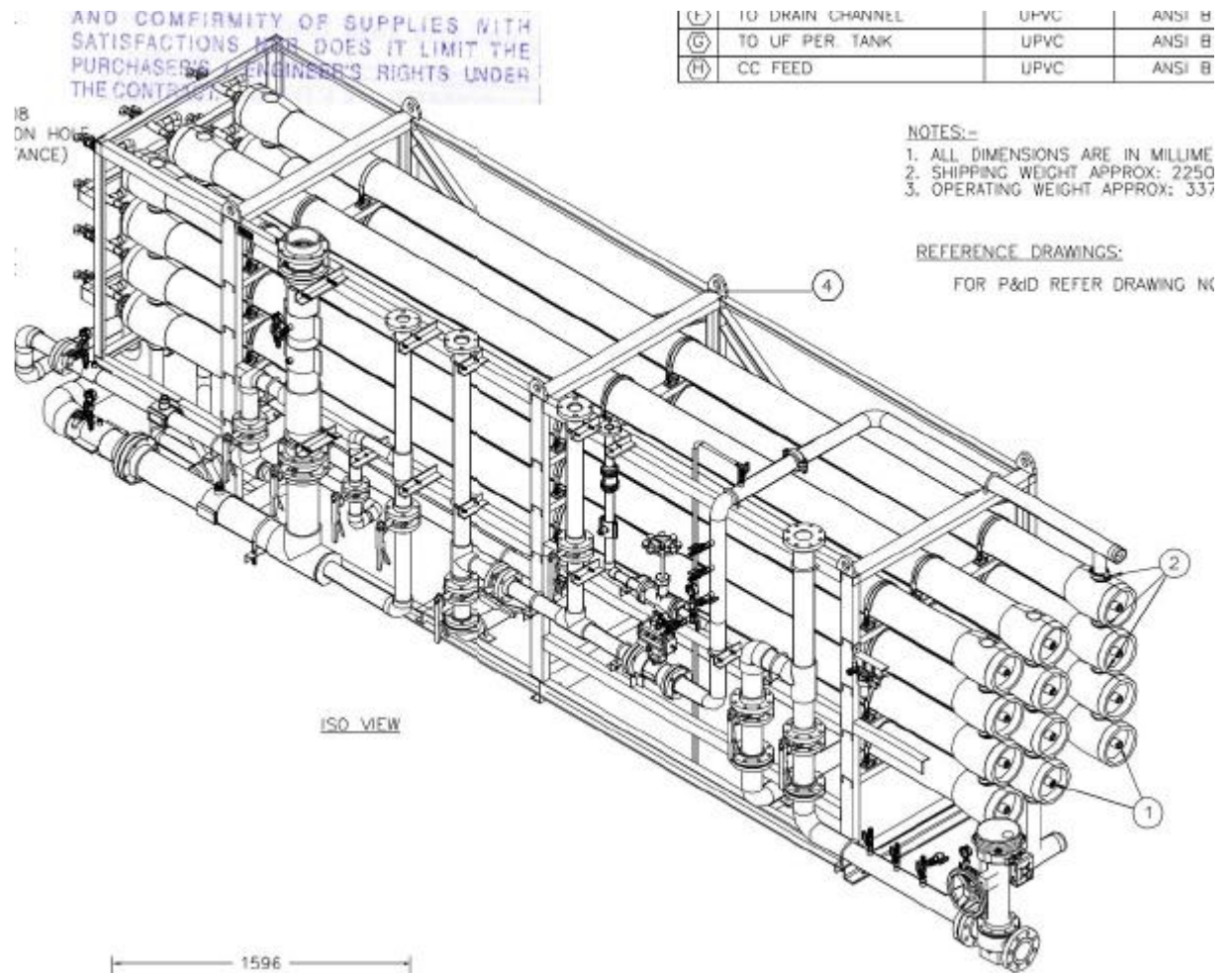
1. Operation and maintenance manual indicating, Operating procedure for start-up, normal operation, chemical cleaning, shut down and emergency shut down.
2. Maintenance instruction & assembly
3. Lubrication chart.
- 5 RO system Logic diagram & Sequential Flow Chart (SFC) for DCS
- 6 Cable interconnection diagram for cables up to junction box & cable schedule.
- 7 Test Certificates for all the supplied instruments.
- 8 List of alarm, interlock & trip set points
- 9 Installation drawings for instruments
- 10 Wiring drawings & GA drawings for Local Panels, junction boxes.
- 11 As built drawings
- 12 All other details called in Electrical specification.

## **12.0 ATTACHMENTS**

**The following drawings enclosed are a part of the specification:**

- |                                  |                         |
|----------------------------------|-------------------------|
| 1. PID for RO system             | : 1-WT-150-01043 Rev:00 |
| 2. Equipment layout              | : 1-WT-150-01045 Rev:00 |
| 3. E C&I technical specification | : ROS : 4172            |
| 4. Vendor list                   | : Annexure- I attached  |

## 12.1 Typical RO skid:



|                                                                                   |                                       |                   |
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### Annexure-1

## GUARANTEE DATA SHEET

### I PERMEATE WATER QUALITY : RO STAGE-1

| Sl.No. | Description                      | Unit      | Values |
|--------|----------------------------------|-----------|--------|
| 1      | Total Dissolved solids           | ppm       | < 80   |
| 2      | Total Permeate output per stream | cu.m / hr | 45     |

### II PERMEATE WATER QUALITY : RO STAGE – 2

| Sl.No. | Description                      | Unit      | Values |
|--------|----------------------------------|-----------|--------|
| 1      | Total Dissolved solids           | ppm       | < 10   |
| 2      | Total Permeate output per stream | cu.m / hr | 22     |

### III MEMBRANE LIFE GUARANTEE

| Sl.No. | Description               | Unit  | Values                                                    |
|--------|---------------------------|-------|-----------------------------------------------------------|
| 1      | Life of Membrane elements | years | <b>Three years<br/>from the date of<br/>commissioning</b> |

|                                                                                   |                                               |                   |
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## Annexure-2

### ELECTRICAL POWER CONSUMPTION

| Sl.<br>No. | Equipment Description                        | Qty |    | Drive<br>rating<br>KW | Conn<br>load.<br>Load<br>KW | Power<br>consumption<br>KW** | Voltage,<br>Phase |
|------------|----------------------------------------------|-----|----|-----------------------|-----------------------------|------------------------------|-------------------|
|            |                                              | W   | SB |                       |                             |                              |                   |
| <b>A</b>   | <b>FOR CONTINUOUS<br/>OPERATING EQPT.</b>    |     |    |                       |                             |                              |                   |
| 1          |                                              |     |    |                       |                             |                              |                   |
| 2          |                                              |     |    |                       |                             |                              |                   |
| 3          |                                              |     |    |                       |                             |                              |                   |
| 4          |                                              |     |    |                       |                             |                              |                   |
| 5          |                                              |     |    |                       |                             |                              |                   |
| 6          |                                              |     |    |                       |                             |                              |                   |
| 7          |                                              |     |    |                       |                             |                              |                   |
|            | <i>Sub total of A</i>                        |     |    |                       |                             |                              |                   |
|            |                                              |     |    |                       |                             |                              |                   |
| <b>B</b>   | <b>FOR INTERMITTENT<br/>OPERATING EQPTS.</b> |     |    |                       |                             |                              |                   |
| 1          |                                              |     |    |                       |                             |                              |                   |
| 2          |                                              |     |    |                       |                             |                              |                   |
| 3          |                                              |     |    |                       |                             |                              |                   |
| 4          |                                              |     |    |                       |                             |                              |                   |
| 5          |                                              |     |    |                       |                             |                              |                   |
|            | <i>Grand Total</i>                           |     |    |                       |                             |                              |                   |

Note:            W – Working            SB – Standby



|                                                                                   |                                       |                   |
|-----------------------------------------------------------------------------------|---------------------------------------|-------------------|
|  | SPECIFICATION FOR<br>RO SYSTEM (PWTS) | SPEC.NO.ROS: 6169 |
|                                                                                   |                                       | REV.: 00          |

### Annexure – 3

## EQUIPMENT DATA SHEET FOR RO DESALINATION PLANT

**1.0 LOW PRESSURE PUMPS** : RO CC

### **I. TECHNICAL PARAMETERS**

- 1) Make :
- 2) Model :
- 3) Fluid details
  - Medium handled :
  - PH range :
  - TDS/Chloride range ppm :
  - Temperature range deg.C :
- 4) Rated flow / Head (at Disch) m<sup>3</sup>/hr & mwc:
- 5) Mini. & Max continuous flow m<sup>3</sup>/hr :
- 6) Corresponding discharge Head mwc :
- 7) Shut-off head mwc :
- 8) NPSH required (minimum) mwc :
- 9) Design Pressure kg/cm<sup>2</sup> :
- 10) Hydraulic test pressure kg/cm<sup>2</sup> :
- 11) Pump efficiency at duty point % :
- 12) BkW reqd. for pump at duty point kw :
- 13) Maximum KW required kw :
- 14) Recommended Motor KW kw :
- 15) Rated speed rpm :
- 16) Noise level at duty range dbA :
- 17) Vibration level peak to peak mm :
- 18) Balancing quality :

### **II. CONSTRUCTION DETAILS**

- 1) Orientation Horizontal / Vertical :
- 2) Suction / Discharge nozzle
  - Size mm :
  - Rating psi :
  - Orientation :
  - Material :
- 3) Material of Construction / Make
  - Pump Casing :
  - Impeller :
  - Shaft :
  - Shaft Sleeve :
  - Fasteners :
  - Others if any :

|                                                                                   |                                                              |                   |
|-----------------------------------------------------------------------------------|--------------------------------------------------------------|-------------------|
|  | <p align="center">SPECIFICATION FOR<br/>RO SYSTEM (PWTS)</p> | SPEC.NO.ROS: 6169 |
|                                                                                   |                                                              | REV.: 00          |

- 4) No. of stages :
- 5) Impeller type :
- 6) Impeller diameter Trimmed / Untrimmed :
- 7) Bearings :
  - Type :
  - Make :
  - Lubrication oil spec. :
- 8) Performance Curve ref Nos. :
- 9) Pump dimension L x W x H :
- 10) Pump Weight :

### III. COUPLING

- 1) Type :
- 2) Make, Model No. :
- 3) Weight kg :

### IV. BASE FRAME AND ACCESSORIES

- 1) Material :
- 2) Dimension detail mm :
- 3) Weight kg :
- 4) Foundation Bolt - Size & Qty mm & Nos. :
  - MOC :

### V. GENERAL

- 1) Shipping package dimension mm :
- 2) Total Assembly / Shipment weight kg :
- 3) List of Special tools :
- 4) Accessories details :
- 5) G.A. Drawing No. :

|                                                                                   |                                               |                          |
|-----------------------------------------------------------------------------------|-----------------------------------------------|--------------------------|
|  | <b>SPECIFICATION FOR<br/>RO SYSTEM (PWTS)</b> | <b>SPEC.NO.ROS: 6169</b> |
|                                                                                   |                                               | <b>REV.: 00</b>          |

## 1.0 HIGH PRESSURE PUMPS : RO Stage-1 RO Stage-2

### I. TECHNICAL PARAMETERS

- 1) Make :
- 2) Model :
- 3) Fluid details :
  - Medium handled :
  - PH range :
  - TDS/Chloride range ppm :
  - Temperature range deg.C :
- 4) Rated flow / Head (at Disch) m<sup>3</sup>/hr & mwc:
- 5) Mini. & Max continuous flow m<sup>3</sup>/hr :
- 6) Corresponding discharge Head mwc :
- 7) Shut-off head mwc :
- 8) NPSH required (minimum) mwc :
- 9) Design Pressure kg/cm<sup>2</sup> :
- 10) Hydraulic test pressure kg/cm<sup>2</sup> :
- 11) Pump efficiency at duty point % :
- 12) BkW reqd. for pump at duty point kw :
- 13) Maximum KW required kw :
- 14) Recommended Motor KW kw :
- 15) Rated speed rpm :
- 16) Noise level at duty range dbA :
- 17) Vibration level peak to peak mm :
- 18) Balancing quality :

### II. CONSTRUCTION DETAILS

- 1) Orientation Horizontal / Vertical :
- 2) Suction / Discharge nozzle :
  - Size mm :
  - Rating psi :
  - Orientation :
  - Material :
- 3) Material of Construction / Make :
  - Pump Casing :
  - Impeller :
  - Shaft :
  - Shaft Sleeve :
  - Fasteners :
  - Others if any :
- 4) No. of stages :
- 5) Impeller type :
- 6) Impeller diameter Trimmed / Untrimmed :
- 7) Bearings :
  - Type :

|                                                                                   |                                               |                   |
|-----------------------------------------------------------------------------------|-----------------------------------------------|-------------------|
|  | <b>SPECIFICATION FOR<br/>RO SYSTEM (PWTS)</b> | SPEC.NO.ROS: 6169 |
|                                                                                   |                                               | REV.: 00          |

- Make :
- Lubrication oil spec. :
- 8) Performance Curve ref Nos. :
- 9) Pump dimension L x W x H :
- 10) Pump Weight :

### III. COUPLING

- 1) Type :
- 2) Make, Model No. :
- 3) Weight kg :

### IV. BASE FRAME AND ACCESSORIES

- 1) Material :
- 2) Dimension detail mm :
- 3) Weight kg :
- 4) Foundation Bolt - Size & Qty mm & Nos.:
- MOC :

### V. GENERAL

- 1) Shipping package dimension mm :
- 2) Total Assembly / Shipment weight kg :
- 3) List of Special tools :
- 4) Accessories details :
- 5) G.A. Drawing No. :

## 2.0 CARTRIDGE FILTER ASSEMBLY: ( Separate data sheet shall be filled for RO Stage -1 , RO stage -2 and Chemical cleaning)

### A. HOUSING

#### I. TECHNICAL PARAMETERS

- a. Make :
- b. Model :
- c. Fluid details
  - Medium handled :
  - pH range :
  - Specific gravity :
  - TDS / Chloride range ppm :
  - Temperature range deg. C :
- d. Rated flow cu.m/hr :
- e. Maximum permitted flow cu.m/hr :
- f. Design Pressure bar(g) :
- g. Test Pressure bar(g) :

|                                                                                   |                                               |                   |
|-----------------------------------------------------------------------------------|-----------------------------------------------|-------------------|
|  | <b>SPECIFICATION FOR<br/>RO SYSTEM (PWTS)</b> | SPEC.NO.ROS: 6169 |
|                                                                                   |                                               | REV.: 00          |

## II. CONSTRUCTION DETAILS OF VESSEL

- a. Vessel Size
- Diameter mm :
  - Thickness
  - Shell mm :
  - Dish end / Cover Plate mm :
  - Cart. Ele. Mounting Plate mm :
  - Straight height mm :
  - Overall height mm :
- b. Capacity to hold no. of cartridges :
- c. Type of cartridge holding arrangement :
- d. Nozzle / End connection
- |                              | Qty | Size | Type | Rating |
|------------------------------|-----|------|------|--------|
| - Inlet                      | :   | /    | /    | /      |
| - Outlet                     | :   | /    | /    | /      |
| - Vent                       | :   | /    | /    | /      |
| - Drain                      | :   | /    | /    | /      |
| - For diff. Press. Indicator | :   | /    | /    | /      |
- e. Orientation of inlet / outlet nozzle :
- f. Flange drilling standard :
- g. Material of construction
- Shell :
  - Cover :
  - Davit :
  - Cartridge holding arrangement :
  - Cover seal :
  - Hand wheel :
  - Fasteners :
- h. Vessel external finish :
- i. Weight of housing
- Empty kg :
  - Loaded kg :

## B. CARTRIDGE ELEMENT

- a. Make :
- b. Model No. :
- c. Material :
- d. Type of end connection / sealing :
- e. Filter loading cu.m/hr/10" cartridge length
- Design :
  - Maximum Allowed :
- f. Filter element rating microns :
- g. Pressure drop
- Guaranteed clean bar(g) :
  - Rec. For element change bar(g) :
  - Maximum permitted bar(g) :

|                                                                                   |                                               |                   |
|-----------------------------------------------------------------------------------|-----------------------------------------------|-------------------|
|  | <b>SPECIFICATION FOR<br/>RO SYSTEM (PWTS)</b> | SPEC.NO.ROS: 6169 |
|                                                                                   |                                               | REV.: 00          |

- h. Quantity per filter Nos. :
- i. Element size
- Diameter OD / ID Inch :
- Length Inch :
- i. End seal type & Material :
- j. Weight per cartridge kg :

### C. GENERAL

- a. Drawing No.
- Vessel :
- Internal Arrgts. :
- Cartridge Element :
- b. Total shipment weight kg :
- c. Shipping size (Lx B x H) Metre : Vessel :
- Element :

### 3.0 GLOBE VALVE –Cage type : (Separate Data sheets for RO stage I and stage II to be submitted)

#### I. TECHNICAL PARAMETERS

#### FCV

#### BCV

- 1) Valve sizes :
- 2) Make :
- 3) Model / Type :
- 1) Fluid details
- Medium handled :
- pH range :
- Specific gravity :
- TDS / Chloride range ppm :
- Temperature range Deg. C :
- 5) Rated flow Cu.m/Hr :
- 6) Design Cv of the valve :
- 7) Calculated Cv :
- 8) Valve rating :
- 9) Pressure Drop for rated flow
- At Full Opening Bar :
- During Regulation Bar :
- 10) Design pressure Bar(g) :
- 11) Hydraulic test pressure
- Body Bar(g) :
- Seat Bar(g) :

#### II. CONSTRUCTION DETAILS

- 1) Material of construction
- Body :
- Bonnet :
- Plug :
- Cage :

|                                                                                   |                                               |                   |
|-----------------------------------------------------------------------------------|-----------------------------------------------|-------------------|
|  | <b>SPECIFICATION FOR<br/>RO SYSTEM (PWTS)</b> | SPEC.NO.ROS: 6169 |
|                                                                                   |                                               | REV.: 00          |

- Sealing Ring :
- Stem :
- Gland :
- Gland Flange :
- Gland Packing :
- Gasket :
- Yoke Bush :
- Hand Wheel :
- Fasteners :
- 2) End Connection / Rating / Standard :
- 3) No. Of turns for 100% opening from  
Closed position :
- 2) Total assembly weight Kg :

### III GENERAL

- 1) Applicable standards :
- 2) Drawing No. - Assembly :
- Cross sectional :
- 3) Valve regulation curve No. :

## 4. Manually / Pneumatic operated Butterfly valves

### I. TECHNICAL PARAMETERS

- a. Make :
- b. Model / Type :
- h. Fluid details
  - Medium handled :
  - pH range :
  - Specific gravity :
  - TDS / Chloride range ppm :
  - Temperature range Deg. C :
- d. Rated flow Cu.m/Hr :
- e. Cv of the valve :
- f. Valve rating :
- g. Pressure Drop ( Maximum) Bar :
- h. Design pressure Bar(g) :
- i. Hydraulic test pressure
  - Body Bar(g) :
  - Seat Bar(g) :
- j. Max. Shut off Pressure Bar(g) :

### II. CONSTRUCTION DETAILS

#### Material of construction

- Body :
- Disc :
- Seat :





|                                                                                   |                                       |                   |
|-----------------------------------------------------------------------------------|---------------------------------------|-------------------|
|  | SPECIFICATION FOR<br>RO SYSTEM (PWTS) | SPEC.NO.ROS: 6169 |
|                                                                                   |                                       | REV.: 00          |

- m. Maximum allowable pr. to Membrane bar(g) :
- n. Feed Flow rates Min./ Max. Cu.M/hr : /
- o. Brine Flow rates Min./ Max. Cu.M/hr : /
- p. Maximum permitted pressure drop : bar  
for the above operating conditions
- q. Maximum permeate back pressure Normal : bar  
Maximum : bar
- r. Maximum permitted temperature Deg.C : /  
for membrane
- s. Minimum permitted temperature Deg.C : /  
for membrane
- t. Average flux rate Design/Maximum l/m<sup>2</sup>/hr : /
- u. Lead element flux rate Design/Max. l/m<sup>2</sup>/hr : /
- v. Salt Rejection-Minimum/Nominal % : /
- w. Standard Test Conditions :
- x. Operating pH range :
- y. Allowable SDI Maximum SDI<sub>15</sub> :
- z. Maximum allowable organic loading  
- TOC ppm :  
- BOD ppm :  
- COD ppm :
- aa. Flux decline coefficient/year % :
- bb. Salt passage increase Factor(SPIF)/Year :
- cc. Membrane projections-Reference :
- dd. Guarantee document-Reference :
- ee. Weight per element Kgs :
- ff. Recommended pressure-vessel make :
- gg. Recommended pressure rating (psi) :

|                                                                                   |                                               |                   |
|-----------------------------------------------------------------------------------|-----------------------------------------------|-------------------|
|  | <b>SPECIFICATION FOR<br/>RO SYSTEM (PWTS)</b> | SPEC.NO.ROS: 6169 |
|                                                                                   |                                               | REV.: 00          |

## 6.0 PRESSURE VESSEL

- a. Make :
- b. Model :
- c. Material of construction
  - Pressure vessel :
  - End Plate :
  - End adapters :
  - Interconnector :
  - Holding strips :
  - Support saddle :
  - O rings :
  - Feed & Brine port :
  - Permeate port :
- d. Quantity of pressure vessels offered set :
- e. Pressure rating psi :
- f. Design Pressure psi :
- g. Test pressure psi :
- h. Burst Pressure psi :
- i. Port size / Orientation
  - Feed : /
  - Brine : /
  - Permeate : /
- j. Port Victaulic Groove Style- Feed :
  - Brine :
  - Permeate :
- k. Empty weight Kgs :
- l. Filled weight Kgs :
- m. Shipment weight Kgs :
- n. Vessel Drawing No. :

## CHEMICAL CLEANING / RE-CIRCULATION TANK (Separate Data sheet for Preparation tank and Cleaning tank to be submitted)

- 1) Capacity ltr :
- 2) Size Dia height mm :
- 3) Tank thick, bottom, circumference, top :
- 4) Baffle plate size and quantity :
- 5) Material of construction :
  - Tank :
- 6) Level indicator :

|                                                                                   |                                                              |                   |
|-----------------------------------------------------------------------------------|--------------------------------------------------------------|-------------------|
|  | <p align="center">SPECIFICATION FOR<br/>RO SYSTEM (PWTS)</p> | SPEC.NO.ROS: 6169 |
|                                                                                   |                                                              | REV.: 00          |

- 7) Type & make of level switches Low/High :
- 8) Level Indicator make & details :
- 9) Nozzle size with Flange details :
  - Inlet :
  - Outlet :
  - Overflow :
  - Drain :
  - Recirculation Inlet :
  - Air vent :
- 10) Colour of the tank :
- 11) No.of man holes & size :
- 12) Weight of tank with :
- 13) Type of resin used for FRP tank :

|                                                                                   |                                               |                   |
|-----------------------------------------------------------------------------------|-----------------------------------------------|-------------------|
|  | <b>SPECIFICATION FOR<br/>RO SYSTEM (PWTS)</b> | SPEC.NO.ROS: 6169 |
|                                                                                   |                                               | REV.: 00          |

**Annexure – 4**

**VALVE SCHEDULE – DATA SHEET TO BE FILLED BY THE BIDDER**

| Sl. No. | Service                 | Valve Type | Size | BODY | Disc / Ball / Diaphragm | Stem / Shaft | Valve seat / Seat ring | Hinge Pin | Valve Ends |
|---------|-------------------------|------------|------|------|-------------------------|--------------|------------------------|-----------|------------|
| 1       | <b>Manual valves</b>    |            |      |      |                         |              |                        |           |            |
|         |                         |            |      |      |                         |              |                        |           |            |
|         |                         |            |      |      |                         |              |                        |           |            |
|         |                         |            |      |      |                         |              |                        |           |            |
| 2       | <b>Pneumatic Valves</b> |            |      |      |                         |              |                        |           |            |
|         |                         |            |      |      |                         |              |                        |           |            |
|         |                         |            |      |      |                         |              |                        |           |            |
|         |                         |            |      |      |                         |              |                        |           |            |
| 3       | <b>Check Valves</b>     |            |      |      |                         |              |                        |           |            |
|         |                         |            |      |      |                         |              |                        |           |            |
|         |                         |            |      |      |                         |              |                        |           |            |
|         |                         |            |      |      |                         |              |                        |           |            |

|                                                                                   |                                       |                   |
|-----------------------------------------------------------------------------------|---------------------------------------|-------------------|
|  | SPECIFICATION FOR<br>RO SYSTEM (PWTS) | SPEC.NO.ROS: 6169 |
|                                                                                   |                                       | REV.: 00          |

# Annexure-5

## List of **RECOMMENDED SPARES**

| Sl.<br>No. | Description of the equipment | Description of spares | Quantity | Price |
|------------|------------------------------|-----------------------|----------|-------|
|            |                              |                       |          |       |
|            |                              |                       |          |       |
|            |                              |                       |          |       |
|            |                              |                       |          |       |
|            |                              |                       |          |       |
|            |                              |                       |          |       |
|            |                              |                       |          |       |
|            |                              |                       |          |       |
|            |                              |                       |          |       |
|            |                              |                       |          |       |

|                                                                                   |                                       |                   |
|-----------------------------------------------------------------------------------|---------------------------------------|-------------------|
|  | SPECIFICATION FOR<br>RO SYSTEM (PWTS) | SPEC.NO.ROS: 6169 |
|                                                                                   |                                       | REV.: 00          |

## ANNEXURE-6

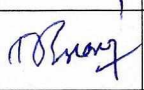
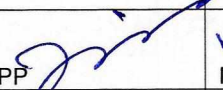
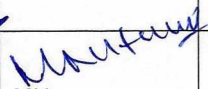
### TECHNICAL DEVIATIONS

| <i>Sl. No</i> | <i>Section no.</i> | <i>Clause No.</i> | <i>Page / No.</i> | <i>Specification</i> | <i>Statement of Deviations/variatio</i> | <i>Reason for Deviation</i> | <i>cost of withdrawal</i> |
|---------------|--------------------|-------------------|-------------------|----------------------|-----------------------------------------|-----------------------------|---------------------------|
|               |                    |                   |                   |                      |                                         |                             |                           |
|               |                    |                   |                   |                      |                                         |                             |                           |
|               |                    |                   |                   |                      |                                         |                             |                           |
|               |                    |                   |                   |                      |                                         |                             |                           |
|               |                    |                   |                   |                      |                                         |                             |                           |
|               |                    |                   |                   |                      |                                         |                             |                           |
|               |                    |                   |                   |                      |                                         |                             |                           |

|                                                                                   |                                              |                         |
|-----------------------------------------------------------------------------------|----------------------------------------------|-------------------------|
|  | <b>SPECIFICATION FOR<br/>RO SYSTEM (ETP)</b> | <b>SPEC.NO.ROS:6170</b> |
|                                                                                   |                                              | <b>REV.: 00</b>         |

**BHARAT HEAVY ELECTRICALS LIMITED,  
RANIPET- 632 406**

**TECHNICAL SPECIFICATION  
FOR  
REVERSE OSMOSIS DESALINATION PLANT  
KILWA PROJECT**

|        |          |                                                                                         |                                                                                        |                                                                                         |             |
|--------|----------|-----------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|-------------|
|        |          |                                                                                         |                                                                                        |                                                                                         |             |
|        |          |                                                                                         |                                                                                        |                                                                                         |             |
|        |          |                                                                                         |                                                                                        |                                                                                         |             |
|        |          |                                                                                         |                                                                                        |                                                                                         |             |
| 00     | 27.06.17 | DBN  | PP  | MN  | Fresh issue |
| Rev.No | Date     | Prepared                                                                                | Checked                                                                                | Approved                                                                                | Remarks     |

|                                                                                   |                                              |                         |
|-----------------------------------------------------------------------------------|----------------------------------------------|-------------------------|
|  | <b>SPECIFICATION FOR<br/>RO SYSTEM (ETP)</b> | <b>SPEC.NO.ROS:6170</b> |
|                                                                                   |                                              | <b>REV.: 00</b>         |

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|                                                                                   |                                                                          |                         |
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|  | <p style="text-align: center;">SPECIFICATION FOR<br/>RO SYSTEM (ETP)</p> | <p>SPEC.NO.ROS:6170</p> |
|                                                                                   |                                                                          | <p>REV.: 00</p>         |

## 1.0 **SCOPE OF SUPPLY**

The intent of this specification is to cover Design, Engineering, Manufacturing, shop testing, supply, and ensuring the performance of the Reverse Osmosis Desalination system as per this specification.

The scope shall fully cover the requirement of the Design Criteria and Technical requirement of this specification for treating the UF filtered water (feed source from Control Monitoring Basin) to meet recycle the permeate water for DM water generation at plant water treatment system. The scope shall include but not limited to the following.

The RO Plant consists of 2x50% working streams. UF treated water shall be used to produce the RO permeate water as per the specified quality & quantity .

Supply of RO skid with necessary Pressure vessel & RO Membrane assembly, piping, valves, electrical, controls and Instrumentation as per Piping and instrumentation diagram No: 1-WT-060-01044,Rev.00.

The scope of supply broadly covers the following items.

- 1) 3x50% cartridge filters with element, air vent & drain valves for RO system
- 2) 3x50% High pressure pumps with VFD-motor for RO system and accessories along with suction & discharge piping & valves for stage I
- 3) VFD panel for RO HP Pumps -1 set
- 4) 2x50% RO skid with pressure vessels, piping, instruments, valves, etc., for RO stage I – 2 sets
- 5) Membrane for RO skid – 2 sets
- 6) Valves for LP & HP piping for RO system – 1 set
- 7) Interconnecting piping for RO system – 1set (LP piping SS 316 sch.10 from Cartridge filters outlet as per P&ID
- 8) Interconnecting HP piping (SS 316L) from HP pumps to RO skid – 1 set
- 9) Electricals controls & instrumentation as per P&ID and ROS:4172 - 1sets
- 10) Foundation bolts , fasteners & gaskets for all equipment's
- 11)Commissioning spares as per specification 1-set
- 12) Mandatory spares as per specification -1 set
- 13)Technical advisory Services for erection stage clearance, commissioning, post commissioning/PG Test for RO system.
- 14)Items though not mentioned, but needed to make the system complete as stipulated under these specifications are also to be furnished unless otherwise specifically excluded.

|                                                                                   |                                                                          |                         |
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## 1.2 GENERAL

- a. The permeate water from the RO system will be collected & stored at RO permeate water storage tank (RCC).
- b. It is not the intent to specify all the details of the design & manufacture. However, the equipment shall conform in all respects to high standard of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to Engineer / Customer, who will interpret the meaning of drawing & the specification and shall be entitled to reject any work or material, which is not in full accordance herewith.
- c. In case of any deviation, the Bidder shall indicate the same, clause by clause in the deviation schedule. In the absence of the same it will be construed that the bid confirms strictly to the specification.
- d. The order of priority of this specification is as follows:
  1. Equipment Specification,
  2. P&ID and Layout
  3. General design requirements
- e. Any contradiction either between various parts or contents of the specification shall be a matter for clarification to be obtained by the bidder. The Customer's decision shall be final. However, as a general guideline the details furnished in the Equipment specification shall prevail.
- f. General terms & conditions, instructions to the tenderer & other attachments referred to elsewhere are part of this specification.

## 2.0 PROJECT INFORMATION

- |                    |   |                                                      |
|--------------------|---|------------------------------------------------------|
| 2.1 Owner          | : | Kilwa Energy Company Ltd.,<br>Tanzania               |
| 2.2 Project Title  | : | 1x371.2 MW natural gas<br>based combined power plant |
| 2.3 Plant location | : | Kilwa Dist, Tanzania, Africa<br>Continent.           |
| 2.4 System         | : | Plant water system / ETP                             |
| 2.5 Vendor scope   | : | Chennai / Mumbai Sea port                            |

|                                                                                   |                                              |                         |
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### 3.0 **TECHNICAL REQUIREMENT**

#### 3.1 **RO PLANT CAPACITY**

RO system shall produce 74 cum/hr of permeate of specified quality continuously by using UF treated water.

The feed water quality for RO system, Permeate quality & quantity of RO system including the performance guarantee requirements are provided in detail in this spec.

#### 3.2 **INLET WATER QUALITY FOR DESIGN OF ETP RO SYSTEM:**

| <b>Sl. No</b> | <b>PARAMETERS</b>                           | <b>UNIT</b> | <b>RESULT</b> |
|---------------|---------------------------------------------|-------------|---------------|
| 1             | SDI <sub>15</sub>                           |             | ≤3.0          |
| 2             | pH Value                                    |             | 7.5 – 8.0     |
| 3             | Total Dissolved Solids (Note)               | ppm         | 2100          |
| 4             | Alkalinity (HCO <sub>3</sub> <sup>-</sup> ) | ppm         | 244.0         |
| 5             | Chloride as Cl                              | ppm         | 1042.56       |
| 6             | Sulphate as SO <sub>4</sub>                 | ppm         | 89.75         |
| 7             | Silica – Dissolved as SiO <sub>2</sub>      | ppm         | <3            |
| 8             | Silica – Colloidal as SiO <sub>2</sub>      | ppm         | 0.00          |
| 9             | Calcium as Ca                               | ppm         | 110.63        |
| 10            | Magnesium -Mg                               | ppm         | 75.9          |
| 11            | Total Hardness                              | ppm         | 186.53        |
| 12            | Sodium-Na                                   | ppm         | 531.30        |
| 13            | Ammonical Nitrogen                          | ppm         | 0.00          |
| 14            | Iron as Fe                                  | ppm         | 0.09          |
| 15            | Manganese as Mn                             | ppm         | 0.0           |
| 16            | Total Kjeldhal Nitrogen                     | ppm         | 0.0           |

|                                                                                   |                                              |                  |
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| Sl. No | PARAMETERS                                              | UNIT  | RESULT |
|--------|---------------------------------------------------------|-------|--------|
| 17     | Total Residual Chlorine                                 | ppm   | 0.5    |
| 18     | Permanganate as KMnO <sub>4</sub>                       | ppm   | 0.0    |
| 19     | Phosphate as PO <sub>4</sub>                            | ppm   | 0.0    |
| 20     | Free Ammonia                                            | ppm   | 0.0    |
| 21     | Total Phosphorous                                       | ppm   | 0.0    |
| 22     | Oil & Grease                                            | ppm   | 0.0    |
| 23     | Nitrate Nitrogen                                        | ppm   | 5.52   |
| 24     | Potassium-K <sup>+</sup>                                | Ppm   | 5.29   |
| 25     | Fluoride as F                                           | ppm   | 0.0    |
| 26     | Copper as Cu                                            | ppm   | 0.0    |
| 27     | Zinc as Zn                                              | ppm   | 0.0    |
| 28     | Lead as Pb                                              | ppm   | 0.0    |
| 29     | Total Chromium as Cr                                    | ppm   | 0.0    |
| 30     | Mercury as Hg                                           | ppm   | 0.0    |
| 31     | Cyanide as CN                                           | ppm   | 0.0    |
| 32     | Phenolic Components as C <sub>6</sub> H <sub>5</sub> OH | ppm   | 0.0    |
| 33     | Nickel as Ni                                            | ppm   | 0.0    |
| 34     | Arsenic as As                                           | ppm   | 0.0    |
| 35     | Temperature                                             | Deg C | 29-31  |

**Note :** The above parameters are tentative and minimum requirement for design of RO system

|                                                                                   |                                              |                  |
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### 3.3 PERFORMANCE & GUARANTEE REQUIREMENT OF RO SYSTEM

The design should meet the outlet water quality at RO outlet as indicated below.

#### 3.3.1 RO Stage - I

##### GUARANTEED RO OUTLET WATER QUALITY & QUANTITY

| S. No | Description                                                | Unit               | Value |
|-------|------------------------------------------------------------|--------------------|-------|
| 01    | RO permeate TDS at the end of membrane life & at 25 deg. C | ppm                | ≤ 200 |
| 02    | Permeate output per stream                                 | m <sup>3</sup> /hr | 37    |
| 03    | RO plant recovery per stream                               | %                  | 75    |

#### **Note:**

All the sub-vendor must have supplied equipment for a similar duty and application with proven experience. These manufacturers / suppliers / sub-vendors should have received ISO 9000 qualification (certification of approval) from International Standard Organization, at least three (3) years old and such qualifications are currently valid. The vendor shall provide evidence to confirm this qualification when requested.

|                                                                                   |                                                             |                         |
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## 4.0 TECHNICAL SPECIFICATION - MECHANICAL

### 4.1 DESIGN CRITERIA

Operation of RO Plant shall be semi-automatic through common DCS system (for UF , RO and EDI Plant). DCS system will be provided by BHEL. Bidder shall render all technical assistance in implementing the sequential operation of their system with the DCS system.

UF treated water is pumped to RO skid by ETP RO feed pumps (2W + 1S). A common Antiscalant dosing system will be provided to remove the scaling tendency of water and Sodium bi-sulphite dosing system will be provided to remove the chlorine in the RO membrane feed water. A common dump valve shall be provided at high flow cartridge filter outlet at RO skid (before HP pump feed). This valve shall open automatically in case any free chlorine is detected in the RO feed water through ORP measurement. 100% of the conditioned feed water from the common header is passed through RO system and the permeate water is collected in the ETP RO product water tank. RO system brine water shall be terminated with a flange near the skid and further leads to the evaporation pond through UPVC pipe line.

A common chemical cleaning system (CIP) shall be provided to restore the membrane performance. The system shall consist of Chemical cleaning pumps (1W+1S), 1 No. of Cartridge filter housing with filter elements, Chemical cleaning tank with necessary piping, valves, drain, air vent, overflow, Man hole , ladder, controls & Instrumentations etc.

Each array (Bank-1&2) shall be cleaned individually for RO system. Necessary piping & valves required to achieve the above requirement shall be provided in RO skid. Necessary piping, pneumatic and manual operated valves, instruments, controls & Interlocks shall be provided in the system for semi-auto operation and also as per the Process & Instrumentation Diagram (1-WT-060-01044 Rev:00) drawing enclosed with this specification.

The details of the equipment / system are elaborated in respective section of this specification.

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## 4.2 TERMINAL POINTS:

- a. UF permeate water (Flow: 101 m<sup>3</sup>/hr & head: 2.0 bar) will be provided by BHEL at the inlet of high flow cartridge filters at one common point. Subsequent header piping from this point to all cart. Filter, HP pumps, RO pressure vessel are in bidder's scope.
- b. RO permeate shall be terminated by bidder at nearby skid outlet of RO skid with a flange & dummy flange and fasteners. Further piping to ETP RO permeate water storage tank (excluded from bidder scope) will be done by BHEL.
- c. RO system brine shall be terminated at the outlet of RO skid with a flange. Further brine transfer will be in BHEL scope. RO cleaning effluent shall be terminated separately by bidder nearby skids. Further disposal/transfer will be done by BHEL.
- d. Required instrument air will be made available by BHEL at one common point of each RO skid. Bidder shall provide the necessary piping with valves for the instrument air within the skid. Bidder shall indicate the quantity of instrument air requirement in their offer.
- e. The required cleaning chemicals for cleaning of membranes will be made available by BHEL. Bidder shall provide the requirement of these chemicals/quantity in their offer for the period of six months.
- f. Power cables for all the drives will be provided by BHEL at the terminal box of respective motors. Local push button station for the respective drives will be in the scope of BHEL. Bidder shall provide the drives list in their offer.
- g. Control cables, instrument cables shall be provided by the bidder up to the junction box (junction box is in bidder scope). BHEL will provide the cables from junction box to DCS/LTMCC panel.
- h. Necessary civil works like skid foundation, trenches are excluded from bidder's scope. However bidder shall provide the details in their offer. The sizes shall be limited to the area specified in the layout drawing enclosed with this specification.
- i. All piping shall be terminated with Flange as per ANSI B 16.5, Cl. 150.

|                                                                                   |                                      |                  |
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### 4.3 EQUIPMENT SPECIFICATION:

#### RO SKID:

##### 4.3.1 PROCESS CARTRIDGE FILTER ASSEMBLY:

- |                |                                      |
|----------------|--------------------------------------|
| a. Equipment   | : Cartridge filter and accessories.  |
| b. Quantity    | : 2W + 1S                            |
| c. Application | : Micron filtration of RO feed water |
| d. Operation   | : Continuous                         |

#### **DESIGN PARAMETERS**

##### a. Fluid details

- |                  |                     |
|------------------|---------------------|
| - Medium handled | : UF Permeate water |
| - pH             | : 6.0 - 8.0         |
| - Temperature    | deg.C : 22 to 35    |

##### b. Operating details

- |                               |                                                       |
|-------------------------------|-------------------------------------------------------|
| - Flow                        | m <sup>3</sup> /hr : ~101                             |
| - Design pressure             | bar(g) : 6 bar                                        |
| - Test pressure               | bar(g) : 1.5 times of Design pressure                 |
| - Pressure drop Initial / Max | bar(g): Bidder to specify                             |
| - Filter loading              | m <sup>3</sup> /hr : Max 1.0 per 10" cartridge length |
| - Nozzle orientation          | : Bidder to decide.                                   |

##### c. Construction details

##### **i) Housing assembly:**

- |                                         |                                                                                             |
|-----------------------------------------|---------------------------------------------------------------------------------------------|
| - Vessel Type                           | : Vertical cylindrical pressure vessel                                                      |
| - Vessel MOC                            | : SS 316                                                                                    |
| - Inlet / Outlet Size & Type            | : Bidder to specify, Flanged                                                                |
| - Flange drilling standard              | : ANSI B16.5, 150 Class                                                                     |
| - Vessel design                         | : As per IS2825 or ASME Sec.VIII but need not be code stamped                               |
| - Air Vent / Drain size                 | : Air vent – 50 NB (to meet the backwash requirement ) & bidder shall decide the drain size |
| - DP Connection (2 Nos)                 | : ½" BSP Female                                                                             |
| - Housing support                       | : Bottom support with three legs                                                            |
| - External surface finish of the vessel | : Mat finish                                                                                |

##### **ii) Cartridge element**

- |                               |                                                                                   |
|-------------------------------|-----------------------------------------------------------------------------------|
| - Cartridge type              | : Depth type, Melt blown bonded, Disposable Polypropylene.                        |
| - End connection of cartridge | : SOE, double external 222 O' rings of Filtration s.a. Code M8 or equivalent make |



|                                                                                   |                                      |                  |
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of the manufacturer.  
- Cartridge length : 40"

- Cartridge Element rating micron : 5 Nominal

- Cartridge OD / ID inch: 2.5" / 1"

d. Material of construction

- Shell : SS316
- Housing Cover & wetted parts : SS316
- Cartridge element : Polypropylene
- Cover seal : Buna-N 'O' ring
- Cartridge holding arrangement : SS316
- All fasteners : SS316
- Davit arrangement : SS304
- Welded parts : SS316

e. Scope of supply per set of Cartridge filter assembly

1. Cartridge filter vessel assembly : 1 Set consists of the following
  - Cartridge filter housing : 1 No.
  - Housing cover with fasteners : 1 Set.
  - Davit arrangement : 1 No.
  - Cartridge holding arrangement : 1 Set
  - Air release valve with piping : 1 set
  - Drain valve with piping : 1 set
2. Cartridge filter elements : 1 Complete set for each vessel to suit above vessel assembly with holding arrangement.

**4.3.2 HIGH PRESSURE PUMP WITH MOTOR :**

- 1) Qty. : 2W + 1SB)
- 2) Operation : Continuous **with VFD**
- 3) Type : Vertical, centrifugal & multistage
- 4) MOC - Casing, Impeller& Stuffing Box: ASTM - A - 351 CF8M
  - All other wetted parts : SS 316
  - Shaft sleeve : SS 410
- 5) Location : Indoor
- 6) Speed of the pump : Not to exceed 3000 rpm
- 7) No. of stages : Bidder to decide based on the functional requirement
- 8) Head developed by pump : Required pressure at the end of the membrane life + friction loss (pipes, fittings & Valves)+5% margin over duty point.
- 9) Flow : 101 cu.m/hr + 5% flow margin
- 10) Impeller type : Closed

|                                                                                   |                                      |                  |
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- |                                                           |                                                                                                                                                         |
|-----------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11) Bearing                                               | : Anti-friction (SKF & FAG)                                                                                                                             |
| 12) Seal                                                  | : Mechanical seal                                                                                                                                       |
| 13) Lubrication                                           | : Oil / Grease / self lubricated                                                                                                                        |
| 14) Coupling                                              | : Vendor to provide                                                                                                                                     |
| 15) Operating range                                       | : 30 – 120% of rated flow                                                                                                                               |
| 16) Pump efficiency (min.)                                | : 70%                                                                                                                                                   |
| 17) Pump characteristic                                   | : Non-overloading type & stable                                                                                                                         |
| 18) Shut-off head                                         | : About 15 % more than the rated head                                                                                                                   |
| 19) All fasteners                                         | : SS316                                                                                                                                                 |
| 20) Accessories                                           | : a) Instrumentation<br>b) Bolts, nuts & sleeves<br>c) Drain plug, vent, priming connection, coupling guard lifting lugs etc.<br>d) Positioning dowels. |
| 21) Motor                                                 | : As per Electrical Spec. in section 5.                                                                                                                 |
| 22) Flange drilling for the pump suction discharge nozzle | : ANSI B16.5, 300 class or higher & to suit the application.                                                                                            |

**Note : HP pumps are to be selected for lowest specified temperature, for the end life of the membranes with the specified fouling factors.**

#### **4.3.3 RO STACK ASSEMBLY (MEMBRANES & PRESSURE VESSELS)**

- |                                  |                                                                                                                        |
|----------------------------------|------------------------------------------------------------------------------------------------------------------------|
| 1) Number of skids required      | : 2-Working                                                                                                            |
| 2) Operation                     | : Continuous / intermittent                                                                                            |
| 3) Qty of raw water input        | : ~51 cu.m/hr per skid                                                                                                 |
| 4) Qty of permeate output        | : ~ 37 cu.m/hr per skid                                                                                                |
| 5) Type of operation             | : Continuous for 24 hours. Operation of RO plant will be automatic through DCS.                                        |
| 6) Plant recovery                | : Min.75 %                                                                                                             |
| 7) Feed water quality            | : As per enclosed specification Clause. 3.2                                                                            |
| 8) Quality of permeate required: | less than 200 ppm                                                                                                      |
| 9) No. of arrays (proposed)      | : ~6:3 (bidder can decide for optimum performance).                                                                    |
| 10) Type of unit                 | : Completely assembled skid mounted unit with associated LP & HP piping, valves, instrumentation, etc. as per our P&ID |
| 11) Skid frame                   | : Carbon steel, with epoxy paint as Per the Painting schedule.                                                         |

#### **4.3.4 RO MEMBRANE ELEMENTS STAGE –I :**

- |                                        |                       |
|----------------------------------------|-----------------------|
| 1) No. of Streams                      | : 2 Working           |
| 2) Permeate output capacity per stream | : 37 m3/hr            |
| 3) Size of membrane element            | : 8" dia x 40" length |
| 4) Area per element                    | : 400 sq.ft Max       |

|                                                                                   |                                      |                  |
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|                                         |                                                                                                             |
|-----------------------------------------|-------------------------------------------------------------------------------------------------------------|
| 5) Membrane type                        | : Thin film composite polyamide with<br>: bio-fouling resistance properties (low fouling membranes).        |
| 6) Required plant recovery              | : 75% (min)                                                                                                 |
| 7) Feed water temperature               | }                                                                                                           |
| Design / Min / Max                      | } : 30 / 22 / 35 Deg. C                                                                                     |
| 8) RO feed pH                           | : 5 to 8                                                                                                    |
| 9) Salt rejection (min.)                | : 97.5%                                                                                                     |
| 10) Average Flux                        | : <19 l/m <sup>2</sup> /hr                                                                                  |
| 11) Lead element flux                   | : <27 l/m <sup>2</sup> /hr                                                                                  |
| 12) Flux Decline Coefficient / Year     | : Min 10%                                                                                                   |
| 13) Salt passage increase factor (SPIF) | : 10% or Bidder to specify per Year<br>(Considering the replacement rate specified below)                   |
| 14) No. of elements / vessel            | : 6                                                                                                         |
| 15) Permeate back pressure              | : 1 bar (g)                                                                                                 |
| 16) Life of membrane                    | : 3 years                                                                                                   |
| 17) Membrane guarantee                  | : RO membrane shall have three years pro-rated warranty as per the membrane manufacturer's recommendations. |
| 18) Accessories required                | : Interconnectors with 'O' ring 1 set per Membrane element.                                                 |
| 19) No. of elements per stream          | : Bidder to specify                                                                                         |
| 20) Supply                              | : As loose packing                                                                                          |
| 21) Membrane Assy with PV               | : Will be done at site                                                                                      |

**Note:** 1. RO membrane shall be have 3 years prorated warrantee as per the membrane manufacturer's recommendations.

2. Skid assembly shall be hydro tested before dispatch in presence of BHEL/BHEL authorized agency.

|                                                                                   |                                      |                  |
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#### 4.3.5 RO PRESSURE VESSELS:

- 1) Material of construction : GRP
- 2) Vessel Size : To house spiral wound RO-membranes of 8" dia, 40" length each.
- 3) No. of elements per vessel : 6
- 4) Pressure Rating : 300 psi (non coded)
- 5) Design pressure : 300 psi
- 6) Test pressure : As per ASME SEC-X / as per the design code.
- 7) Burst Pressure : As per ASME SEC-X / as per the design code.
- 8) Quantity required : Bidder to specify
- 9) Feed port :-
  - port orientation : Side port – 1no per vessel
  - port size : ~1.5" with victaulic grooves
  - MOC : SS316L
- 10) Brine port :-
  - port orientation : Side port – 1no per vessel
  - port size : ~1.5" with victaulic grooves
  - MOC : SS316L
- 11) Permeate port :-
  - port orientation : End port –2 nos per vessel
  - port size : ~1" / 1.5" (with threaded end cap on both sides)
  - MOC : Engineering thermoplastic.
- 12) Flexible coupling/equivalent to Victaulic/Piedmont:
  - Size : Vendor to decide.
  - MOC : SS316

**Note :** Adequate air vent shall be provided at feed, permeate & brine piping.

|                                                                                   |                                              |                  |
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#### 4.5.0 GLOBE VALVES – CAGE TYPE

##### 4.6.1 GENERAL:

- 1) Equipment : SS316 Globe Valve (Cage type)
- 2) Class : Cl. # 300
- 3) Application : For regulation purpose in RO desalination plant  
For smooth control of feed flow & pressure between the operation ranges as called by membrane projection, life of membrane, temperature range etc.,
- 4) Installation : Indoor
- 5) Ambient Temperature : 15 deg.C to 45 Deg.C Maximum
- 6) Operation : Continuous

##### 4.6.2 DESIGN PARAMETERS

- 1) Fluid details
  - Medium handled : Filtered brackish water
  - pH : 3 to 11
  - Specific gravity : 1.00
  - Temperature Deg.C : 20 to 40
- 2) Material of construction
  - Body : SS316
  - Bonnet : SS316
  - Plug / Disc : SS316
  - Stem / Shaft : SS316
  - Seat Ring : SS316
  - Cage : SS316
  - Fasteners & wetted parts : SS316

##### 4.6.3 DESIGN DETAILS:

###### A. FEED CONTROL VALVE (FCV) for RO System

- 1) Purpose : To regulate the feed pressure in the RO plant.
- 2) Type : Cage type
- 3) Valve size : Bidder to decide
- 4) End connection : Flanged , ANSI B 16.5, 300 Class  
(Bidder to confirm)
- 5) Pressure drop at full opening : Minimum possible
- 6) Max. feed TDS / Cl : Bidder to decide
- 7) Rated flow Cu.m/hr : 101
- 8) Operating Pressure Norma/Max : Bidder to decide
- 9) Nominal pipe size : Bidder to decide

|                                                                                   |                                              |                  |
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**NOTE:** Bidder to select the valves suitable for downward pressure regulation of 10 bar from the operating pressure by manual adjustment and also indicate the % of lift for above adjustment.

#### **B. BRINE CONTROL VALVE (BCV)**

- 1) Purpose : To control & Create back pressure in the RO Desalination plant
- 2) Valve size : Bidder to decide
- 3) End connection : Flanged, ANSI B 16.5, 150 or 300 Class (Bidder to confirm)
- 4) Pressure drop at full opening : Minimum possible
- 5) Max. Brine TDS / Cl : Bidder to decide
- 6) Rated flow Cu.m/hr : 27
- 7) Operating Pressure Norma/Max : Bidder to decide
- 8) Nominal pipe size : Bidder to decide

**NOTE:** Bidder to select the valves suitable for downward pressure regulation nearing to atmospheric pressure from the operating pressure by manual adjustment.

#### **4.7.0 SILENT CHECK VALVE (NON-SLAM) :**

- 1) Equipment : SS316 Silent Check (non-Slam)
- 2) Class : Cl.# 300
- 3) Mounting Type : Flange
- 4) Valve size : bidder to decide
- 5) MOC : SS316
- 6) Ambient Temperature : 15 -45 Deg. C
- 7) Application : To arrest back flow to RO HP Pump
- 8) Operation : Continuous

#### **4.8.0 GENERAL DESIGN REQUIREMENTS**

The common requirements for the system are stated in the general design requirements of this section. However the requirements indicated in the specification for mechanical equipment section 4.3.1 to 4.3.5 shall be strictly complied with.

The RO SKIDs shall be a completely assembled skid mounted units including the components mentioned in cl. 4.3.4, to 4.3.5 with associated LP & HP piping, valves, instrumentation, etc, as per our P & ID enclosed with this specification

|                                                                                   |                                                                          |                         |
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#### 4.8.1 COMMON REQUIREMENTS FOR ALL SYSTEM:

1. All the rotating equipments noise level shall be < 85db measured at 1 mtr distance from the equipment.
2. Only latest revision of standard shall be used.
3. Sampling connections and air vent at the top most point of piping and vessels shall be provided at all stages of the Unit.
4. All the valves are to be located to facilitate easy accessibility and operation from the ground level.
5. All fasteners shall be of SS 316.
6. Bidder shall follow the Bidder list (approved by the Customer) only for all their equipment, sub-systems and components.
7. Customer's inspection at Bidder's works is applicable for specified components as per the approved QP /spec.
8. All UPVC pipe lines (piping, fittings, & valves) shall be Georg Fisher, FIP & Astral.
9. Bidder shall submit detailed process calculations and major system drawings for the approval of BHEL's Customer. These documents require approval of the Customer before commencement of the work.

#### 4.8.2 CENTRIFUGAL PUMPS:

1. The maximum efficiency of the pumps shall be preferably within +5% of the rated design flow indicated in the data sheet.
2. Total head capacity curve shall be continuously rising from the operating point towards shut-off without any zone of instability and with a minimum shut off head of 15 % more than design head.
3. Pumps of a particular category shall be identical and shall be suitable for parallel operation with equal load division.
4. Components of identical pumps shall be interchangeable.
5. The noise level shall not exceed 85dBA at a distance of 1m from the equipment.
6. The pump shall be capable of starting with discharge valve fully open and close condition
7. Continuous motor rating at 50 deg.C ambient shall be at least 10% above the maximum load demand of the pump in the entire operating range to take care of the system frequency variation.
8. The critical speed of the pumps shall be well away from the operating speed and in no case less than 130% of the rated speed.
9. Tolerance on pump guaranteed efficiency and rated head for the rated flow shall be plus or minus 3%.
10. Pressure gauges shall be provided on discharge side of all pumps.(excluded)
11. Each pump suction and discharge shall be installed with an expansion bellow.
12. The pumps shall be controlled from remote panel and locally.

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## 4.9.0 PIPING

### 4.9.1 LINE SIZING

1. Sizes of pipelines shall be selected such that the velocity of fluid in pipes does not exceed the following limits under conditions of maximum possible volumetric flow:
  - Pump Suction : < 1.2 m/sec
  - Pump Discharge & re-circulation : 1.5 to 2.5 m/sec for UPVC & MSRL Pipe line.
  - : < 2.5 m/Sec for SS316 Pipe line
  - High pressure pump discharge : < 3.5 m/sec
  - Service water / Potable water : 1.5 m/sec
  - Compressed air : 6 m/Sec
2. Corrosion allowance of 1.6mm shall be added to the calculated thickness.
3. All high points in piping system shall be provided with vents along with valves. All low points shall be provided with drains along with valves.
4. Compressed air pipe work shall be adequately drained to prevent internal moisture accumulation and moisture traps shall be provided at strategic location in piping system.
5. Supporting arrangement of piping system shall be properly designed for systems where hydraulic socks and pressure surges may arise in the system during operation
6. Overhead piping shall have a normal minimum vertical clearance of 2.5 mtrs above walkways and working areas and 8mtrs above roadways / railways.
7. Sufficient up stream and down stream lengths shall be provided for flow measuring device, control valves and other specialties.
8. Materials:
  - All materials shall be new and procured preferably from the manufacturer.
  - Test certificate / compliance certificate to be furnished by the bidder for all the components instruments & piping etc.



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#### 4.9.2 MATERIALS OF CONSTRUCTION:

| SL. NO. | SERVICE                                                                                                               | SIZE         | PIPES                                   | FITTINGS                                                    | FLANGES                                                   | GASKETS                | LINE JOINT                 |
|---------|-----------------------------------------------------------------------------------------------------------------------|--------------|-----------------------------------------|-------------------------------------------------------------|-----------------------------------------------------------|------------------------|----------------------------|
| 1.0     | <b>Low Pressure Application</b>                                                                                       |              |                                         |                                                             |                                                           |                        |                            |
| 1.1     | UF permeate water, Degassed water, Service water, treated effluent disposal, RO Permeate, Chemical Cleaning, rinsing, | Upto DN 200  | UPVC , PN10 as per latest DIN standard  | UPVC , PN10 as per latest DIN standard                      | UPGF / PP Flange drilling should be ANSI B16.5, 150 Class | Neoprene rubber gasket | Solvent cemented / flanged |
|         |                                                                                                                       | Above DN 200 | SS 316L                                 | SS 316L                                                     | SS 316                                                    | EPDM rubber gasket     | Flange/ insitu joint       |
| 1.2     | Instrument Air & Plant Air line                                                                                       | All sizes    | Galvanised as per IS 1239 , Heavy grade | Screwed fittings of Galvanised as per IS 1239 , Heavy grade | Not applicable. Screwed fitting shall be considered       | Not applicable         | Screwed connections        |
| 2.0     | <b>High Pressure Application</b>                                                                                      |              |                                         |                                                             |                                                           |                        |                            |
| 2.1     | High Pressure Lines                                                                                                   | All sizes    | ASTM A-312 TP 316L - ERW, SCH40         | ASTM A182F 316L Butt welded fittings, SCH40                 | Socket welded, as per ANSI B16.5, 150 Class               | Neoprene rubber gasket | Butt welded                |

#### Notes

1. Pipes shall be tested for its material composition and certificate shall be enclosed for the same.
2. All branch connections shall be wrought or forged steel based on the size and availability based on ASTM Standards.
3. All piping & valves supports shall be of dismantling type for easy maintenance using suitable bolted connections.
4. For LP piping: UPVC up to DN 200 and SS 316 for size above DN 200.

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## 4.10. VALVES

### 4.10.1 DESIGN AND CONSTRUCTION FEATURES

The following consideration shall be made during the design / selection of valves for the RO System.

1. For the RO system, Butterfly valves and diaphragm type valves shall be used for isolation / regulation purpose.
2. Bidder to select suitable material of construction for the valves based on the system requirement as per clause 4.6.2.
3. The end connection for the diaphragm valves shall be of flanged type as per ANSI B16.5, 150 class.
4. Pressure rating of valves shall be of minimum PN10
5. Necessary pneumatic actuated valves shall be provided for auto operation & Chemical cleaning of the plant as per the P & I diagram.
6. The painting shall be as per the requirements indicated in the painting specification.
7. In the HP pump discharge a silent (non-slam) check valves with single disc wafer type shall be installed.
8. Butterfly valves shall be of wafer type suitable for mounting between flanges.
9. The Material of Construction of the body and disc of check valve shall be SS 316.
10. Bidder shall furnish the valves schedule in the attached format. (Annexure - 4)
11. Cast steel valves shall be provided for compressed air system.
12. Ball valves or Plug valves shall be provided for oil and air system.

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#### 4.10.2 VALVE – MATERIALS

| Sl. No. | Service                                             | Valve Type            | Size   | BODY                                                | Disc / Ball / Diaphragm    | Stem / Shaft               | Valve seat / Seat ring | Hinge Pin | Valve Ends                 |
|---------|-----------------------------------------------------|-----------------------|--------|-----------------------------------------------------|----------------------------|----------------------------|------------------------|-----------|----------------------------|
| 1       | UF permeate water, Degassed water and Service water | UPVC Ball Valve       | ≤50 NB | UPVC                                                | UPVC                       | UPVC                       | PTFE                   | ---       | Solvent cement Socket End  |
|         |                                                     | UPVC Ball Check Valve | ≤50 NB | UPVC                                                | UPVC                       | ---                        | EPDM                   | ---       | Solvent cement Socket End  |
|         |                                                     | Butterfly Valve       | ≥65NB  | CI                                                  | SS316                      | SS316                      | EPDM                   | ---       | Lugged /Wafer Construction |
|         |                                                     | Check Valve           | ≥65NB  | ASTM A 351, Gr.CF 8M /                              | ASTM A 351, Gr.CF8M        | Stainless Steel            | Stainless Steel        | AISI 316  | Lugged/ Wafer Construction |
| 2       | Non slam silent check valve                         | Wafer type            | ≥65 NB | SS316                                               | SS316                      | SS316                      | EPDM                   |           | Wafer type                 |
| 3       | Chemical dosing Line                                | UPVC Ball Valve       | ≤50 NB | UPVC                                                | UPVC                       | UPVC                       | PTFE                   | ---       | Solvent cement Socket End  |
| 4       | Chemical Cleaning Line                              | UPVC Ball Valve       | ≤50 NB | UPVC                                                | UPVC                       | UPVC                       | PTFE                   | ---       | Solvent cement Socket End  |
|         |                                                     | Butterfly Valve       | ≥65NB  | CS                                                  | ASTM A 351, Gr.CF8M        | SS316                      | EPDM                   | ---       | Lugged /Wafer Construction |
|         |                                                     | Check Valve           | ≥65NB  | ASTM A 351, Gr.CF 8M /                              | ASTM A 351, Gr.CF8M        | Stainless Steel            | Stainless Steel        | AISI 316  | Lugged/ Wafer Construction |
| 5       | Compressed air application                          | Ball Valve            | ≤50 NB | Galvanized cast carbon steel or Forged carbon steel | Stainless Steel / ANSI 420 | Stainless Steel / ANSI 420 | Nitrile Rubber / PTFE  | ---       | Flanged End                |

#### Notes

1. Valves : UPVC up to DN 50, CI body with SS 316 disc for size above DN 50

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#### 4.11.0 PAINTING

All the Equipment and steel structures shall be protected against external and internal (if any) corrosion by providing suitable painting as described below unless otherwise specified elsewhere. However, the surfaces of stainless steel, Galvanised steel, Gunmetal, brass, bronze, UPVC pipes, HDPE pipes and non-metallic components shall not be applied with any painting.

All painting shall be carried out in conformity with the paint manufacturer's recommendation.

##### a. SCOPE

This section covers the painting requirements for skids, equipment & Accessories.

##### b. CODES AND STANDARDS

Painting of equipment shall be carried out as per the specifications indicated below and shall conform to the relevant IS specification for the material and workmanship.

IS: 5 : Colours for ready mixed paints and enamels  
IS: 1303 : Glossary of terms relating to paints  
IS: 9954 : Surface Preparation standard for painting of Steel surfaces.

##### c. PREPARATION OF SURFACES

All surfaces to be painted shall be thoroughly cleaned of all grease, oil, loose mill scale, dust, rust and any other foreign matter. Mechanical cleaning by power tool and scrapping with steel wire brushes shall be adopted to clear the surfaces. However, in certain locations where power tool cleaning cannot be carried out; sand scrapping may be permitted with steel wire brushes and/or abrasive paper. Cleaning with solvents shall be resorted to only in such areas where other methods specified above have not achieved the desired results. Cleaning with solvents shall be adopted only after written approval of the OWNER / ENGINEER.

##### d. PRIMER PAINT

After the surface is prepared, one coat of Zinc phosphate epoxy primer shall be applied. After this first coat is dried up completely, second coat shall be applied. Primer shall be applied by brushing to ensure a continuous film without 'holidays'. The total dry film thickness of shall be minimum 100 microns.

##### e. INTERMEDIATE COAT PAINT

After the primer coat, one intermediate coat of Micaceous Iron Oxide / Titanium dioxide shall be applied. The dry film thickness shall be minimum 150 microns.

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**f. FINISH PAINT**

One layer of Polyester Urethane, shall be used for finish coat. The colour/shade shall be as approved by the OWNER. Dry film thickness of 50 microns.  
The total system DFT after finish painting shall be minimum 300 microns.

**g. SUGGESTED COLOUR CODES FOR PAINTING:** IS-5, shade 631, Light Grey.

**4.12.0 PACKING:**

Being export Order Sea worthy packing shall be done to meet the requirement. For further details, please refer attached specification No. PE-TS-888-100-A001, Vol II B, section D.

**4.13.0 SUB- VENDOR LIST FOR RO SYSTEM**

Please refer to the enclosed sub-vendor list **Annexure- I**

**5.0 TECHNICAL SPECIFICATION FOR ELECTRICAL, CONTROLS & INSTRUMENTATION**

Electrical, Controls & Instrumentation requirements for the RO system is attached separately along with this specification. **ROS: 4172**

**6.0 TECHNICAL DETAILS FOR CIVIL WORKS:**

Construction of civil building, foundation and flooring etc for the RO system is not in bidder scope. However the bidder shall provide the equipment layout drawing along with bid. The approximate area of the RO building is indicated in the enclosed preliminary drawing. Detailed construction drawing with foundation requirement like load details, foundation pockets etc, for all the equipments including tanks, flooring requirements, trenches for pipe routing, cable routing & drains etc. shall be furnished to BHEL for further construction immediately after order. Any special requirement like handling arrangement, floor / trench protection etc. shall also be indicated in the drawings. All the plant drains & trenches are to be connected in a common trench and terminated near RO Plant boundary. Foundation bolts, nuts & washers for all equipments supplied by the bidder are in their scope.

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## 7.0 PERFORMANCE GUARANTEE

The system performance guarantees applicable are detailed in this section.

In addition to the guarantees mentioned in earlier clause, the requirements of specifications on all guarantees as elaborated under relevant clauses of Technical Specifications should be met.

The guarantee for the equipment shall start after 18 months from the date of supply (or) 12 months from the date of commissioning, whichever is earlier.

Any part which proves defective either in design, materials / and / or manufacture within the above guarantee period shall be replaced at free of cost to the owner at site and the provision of this clause shall apply to the portions of the plant so replaced or renewed until the expiration of the guarantee period or from the date of replacement whichever is later.

### 7.1 PERFORMANCE GUARANTEE TEST

The bidder shall guarantee all equipment's for workmanship, materials and satisfactory performance. The guarantee for performance will cover individual items and systems including electrical for their ratings / outputs as well as for the integrated operation of equipment and its auxiliaries as a whole.

On completion of satisfactory commissioning, the supplier shall conduct performance / acceptance tests on the equipment and system as a whole for demonstrating the guaranteed performance parameters specified. All instruments, gauges installed for the normal operation of equipment shall, be made use of during the acceptance test as far as possible. If additional instruments are required for the tests, these shall be brought by supplier free of cost and shall be taken back after performance test.

The guarantee tests shall cover the following but not limited to the rated parameters for smooth operation of complete RO system:

- a. RO Permeate water quality as per enclosed specification clause 3.3
- b. RO system net output and recovery
- c. Power consumption for continuous operating equipment as per Annexure-2
- d. Vibration and noise level of rotating equipment.

**7.2** Duration of PG test shall be as per the approved PG test procedure by the customer. performance test run shall be conducted for the guaranteed values of treated water quality, quantity and other performance parameters.

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### 7.3 PERFORMANCE BANK GUARANTEE (PBG):

The successful bidder will have to provide a BG of **10 %** of the contract value for overall performance of the plant until the expiry of the guarantee period.

## 8.0 SPARES

### 8.1 Commissioning spares:

The bidder shall provide commissioning spares and the commissioning spares shall be delivered along with main supply. The commissioning spares list is indicated in this section. Over and above any additional requirements for trouble free commissioning of the equipment / system shall be included in the list. The price for the commissioning spares shall be included in the main supply and the list shall be provided along with the bid, this price will be included for bid evaluation.

#### 8.1.1 Cartridge filters:

| Sl. No | Spares Description | Type of spare                         | Qty. | Unit |
|--------|--------------------|---------------------------------------|------|------|
| 1      | Cartridge filters  | Cartridge filter elements             | 02   | sets |
| 2      | Cartridge filters  | Gaskets for each type of Cart. Filter | 1    | Set  |

#### 8.1.2 RO MEMBRANE:

| Sl. No | Spares Description | Type of spare          | Qty. | Unit |
|--------|--------------------|------------------------|------|------|
| 1      | Inter connector    | Connector With O-rings | 10   | sets |

#### 8.1.3 INSTRUMENTS :

| Sl. No | Spares Description | Type of spare                | Qty. | Unit |
|--------|--------------------|------------------------------|------|------|
| 1      | ORP Analyzer       | Complete set of ORP Analyzer | 1    | set  |

|                                                                                   |                                              |                          |
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## 8.2.0 Mandatory Spares

The price for the mandatory spares shall be given separately and shall not be included in the main supply. The list of the mandatory spares is as given below. Mandatory spares shall be packed separately with detailed packing list (items should not be packed along with main supply items)

All spares supplied under this Contract shall be strictly interchangeable with the parts for which they are intended for replacements. The spares shall be treated and packed for long storage under the climatic conditions prevailing at site e.g small item shall be packed in sealed transparent plastic bags with desiccator packs as necessary.

Each spare shall be clearly marked or labelled on the outside of the packing with its description. When more than one spare part is packaged in a single case, a general description of the contents shall be shown on the outside of such case and a detailed list should be enclosed. All cases, containers and other packages must be suitably marked and numbered for the purpose of identification.

Bidder to quote for the following mandatory spares.

(a). Mechanical

| Sl. No | Spares Description    | Type of spare             | Qty                                 | Unit |
|--------|-----------------------|---------------------------|-------------------------------------|------|
| 1      | Cartridge Filters     | Cartridge filter elements | 10% of the total installed elements |      |
| 2      | RO High Pressure Pump | <b>If vertical pump</b>   |                                     |      |
|        |                       | Shaft sleeves             | 1                                   | set  |
|        |                       | Bearing                   | 1                                   | set  |
|        |                       | Wear rings                | 1                                   | set  |
|        |                       | Impeller                  | 1                                   | set  |
|        |                       | Complete shaft            | 1                                   | set  |
|        |                       | Shaft sleeve              | 1                                   | set  |
|        |                       | Packing                   | 1                                   | set  |
|        |                       | Mechanical seal           | 1                                   | set  |
|        |                       | Seals                     | 1                                   | set  |
|        |                       | Fasteners                 | 1                                   | set  |
|        |                       | Couplings                 | 1                                   | set  |
|        |                       | Bushes                    | 1                                   | set  |
|        |                       | All gaskets               | 1                                   | set  |
|        |                       | “O” rings                 | 1                                   | set  |
|        |                       | Impeller nut              | 1                                   | set  |



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|   |                               |                                                       |                                 |     |
|   | RO High Pressure Pump         | <b>If horizontal pump</b>                             |                                 |     |
|   |                               | Shaft sleeves                                         | 2                               | set |
|   |                               | Casing wear ring                                      | 2                               | set |
|   |                               | Pump bearing                                          | 2                               | set |
|   |                               | Fasteners                                             | 1                               | set |
|   |                               | Complete coupling (pump & motor)                      | 1                               | set |
|   |                               | Mechanical seal                                       | 1                               | set |
| 3 | RO Membranes for RO skid      | RO membrane (low fouling)                             | 10% of total installed membrane |     |
| 4 | RO pressure vessel            | Rupture disc /End plate assy.                         | 20                              | Nos |
| 5 | Complete Globe valve          | 10% of population of each type & size with min. 1 no. |                                 |     |
|   | Disc (Globe valve)            | 10% of population of each type & size with min. 1 no. |                                 |     |
|   | Stem (Globe valve)            | 10% of population of each type & size with min. 1 no. |                                 |     |
|   | Seal ring                     | 10% of population of each type & size with min. 1 no. |                                 |     |
|   | Gasket                        | 10% of population of each type & size with min. 1 no. |                                 |     |
|   | Yoke bush                     | 10% of population of each type & size with min. 1 no. |                                 |     |
| 6 | Butterfly valve               | 10% of population of each type & size with min. 1 no. |                                 |     |
|   | Reduction gear operator (BFV) | 10% of population of each type & size with min. 1 no. |                                 |     |
|   | Disc (BFV valve)              | 10% of population of each type & size with min. 1 no. |                                 |     |
|   | Stem (BFV)                    | 10% of population of each type & size with min. 1 no. |                                 |     |
|   | Seal ring                     | 10% of population of each type & size with min. 1 no. |                                 |     |
|   | Bearing (BFV)                 | 10% of population of each type & size with min. 1 no. |                                 |     |
|   | Gasket                        | 10% of population of each type & size                 |                                 |     |

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|   |                          | with min. 1 no.                                        |
| 7 | Check valve              | 10% of population of each type & size with min. 1 no.. |
|   | Flap/Door with pin (NRV) | 10% of population of each type & size with min. 1 no.  |
|   | Flap rings (NRV)         | 10% of population of each type & size with min. 1 no.  |

(b). Electrical

| <b>Sl. No</b> | <b>Spares Description</b>      | <b>Unit</b> | <b>Quantity/set</b> |
|---------------|--------------------------------|-------------|---------------------|
| a)            | Motor for RO HP pump           | No          | 01                  |
| b)            | Bearing for RO stage-1 HP pump | Set         | 01                  |

(c). Instruments

| <b>S. No</b> | <b>Item Description</b>                             | <b>Quantity / Unit</b>                                                                  |
|--------------|-----------------------------------------------------|-----------------------------------------------------------------------------------------|
| <b>1</b>     | <b>CONTROL &amp; INSTRUMENTATION</b>                |                                                                                         |
| 1.1          | Local gauges (pressure, temperature, level, flow)   | 10% for each type and range subject to minimum 2 nos.                                   |
| 1.11         | Solenoid valve                                      | 10% for each type and size subject to minimum 2 nos.                                    |
| 1.12         | Flow meters                                         | Accessories (as recommended by the manufacturer) - minimum 2 nos in each type and size. |
| 1.13         | Transmitters (Pressure, temperature, Flow, level)   | 10% for each type and range subject to minimum 2 nos.                                   |
| 1.14         | Field switches                                      | 10% for each type and range subject to minimum 2 nos.                                   |
| 1.15         | Temperature elements and thermo wells               | 10% for each type, range and pipe size subject to minimum 2 nos.                        |
| 1.16         | SMART positioner                                    | Accessories as per manufacturer recommendation.                                         |
| 1.17         | Air filter regulator                                | 10% for each type and range subject to minimum 2 nos.                                   |
| 1.18         | Limit switches/Torque switches                      | 10% for each type and range subject to minimum 2 nos.                                   |
| 1.19         | Gaskets/Washers / O-Rings (for each size and type)  | 10% for each type and range subject to minimum 2 nos.                                   |
| 1.2          | Conductivity probes                                 | 10% for each type and range subject to minimum 2 nos.                                   |
| 1.21         | Indicators and Electrical metering instruments      | 10% for each type and range subject to minimum 2 nos.                                   |
| 1.22         | Junction boxes (Terminal blocks, cable glands, lug) | 10% for each type and range subject to minimum 2 nos.                                   |
| 1.23         | Terminal blocks, fuses, MCB's for VFD panel         | 10% for each type and size subject to minimum 2 nos.                                    |

Note: For Instrument mandatory spares refer E C&I technical specification **ROS:4172**

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### 8.3.0 Recommended Spares for 2 years O & M :

Bidder also provide the list of recommended spares for two years of normal operation of the plant over & above the mandatory spares. The bidder shall provide the list of recommended & to be filled as per **Annexure-5**

BHEL reserves the right to finalize the exact quantity of recommended spares parts and effect price adjustment on basis of unit rates quoted by the bidders.

The price of recommended spares **will not be considered for bid evaluation.**

The prices of recommended spares shall be consistent with those of the mandatory spares. The validity of prices for these spares shall be up to 2 years.

### 9.0.0 INSPECTION

Inspection by BHEL corporate Quality. Vendor shall submit the QAP for the Customer approval before start-up of the manufacturing.

Manufacturing quality plan shall detail out, for all the components and equipment, various tests/inspection to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by contractor's quality control organization, the relevant reference document and standards, acceptance norms and inspection documents raised etc. during all stages of material procurement, manufacture, assembly and final testing/performance testing.

No materials/equipment shall be dispatched from the manufacturer's works before the same is either accepted subsequent to pre-dispatch final inspection including verification of records of all previous tests/inspections by purchaser's Engineer /authorized representatives, or such pre-dispatch final inspection is waived by the purchaser and dispatch is authorized after review of test reports.

### 10.0 ERECTION, COMMISSIONING & PG TEST:

Erection, commissioning, PG test & Handing over for the RO system shall be as per the requirement mentioned elsewhere in the specification

Successful bidder has to manufacture the equipment as per approved drawing and despatch the materials sequentially required for erection of the RO system. These items shall be transported to site as per purchase instructions. BHEL will receive the materials and store them as received. Bidder shall provide the details of storage procedure & required space well in advance.

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The successful commissioning means, erection of entire system, trial run/trial operation till achieving the performance both in terms of quality (including electrical power consumption) and quantity to prove the agreed performance of the system /equipment and it is ready for PG test.

Technical assistance for maximum of fifteen days (comprising two visits & excluding travels and holidays) at Kilwa site for erection stage clearance, commissioning, post commissioning/PG test. Vendor to include travel to & fro charges, lodging, local conveyance etc., for the above.

Vendor to give optional price for additional visit (one visit consist of minimum three days) which include travel to & fro charges, lodging, local conveyance etc. Also vendor to provide break-up price for the additional visit.

Payments will be made for the actual services utilized at site

## 11.0 DOCUMENTATION:

The documentation during bid and post order stage shall meet the following requirements.

1. All documents and drawing shall be submitted in English
2. Hard copies of all documents and drawings during bid stage to be submitted in duplicate.
3. Hard copies of all documents for approval shall be submitted in triplicate.
4. Hard copies of all final documents, drawings, manual etc., shall be submitted in bound folder in duplicate.
5. Soft copies of all final documents in MS word / MS office in the form of CD –1 set
6. Soft copies of all final calculations in MS excel/ MS officer in the form of CD–1set
7. Soft copies of all final drawings in Auto Cad, latest version in the form of CD-1set

## 11.1 GUARANTEE DOCUMENTS

Bidder shall provide the following guarantee documents along with the bid. Otherwise the offer will be considered as incomplete.

1. RO permeate water quality & Quantity as per Annexure - 1
2. RO Membrane guarantee as per enclosed sample format .
3. Guaranteed power Consumption for normal, continuous operating equipment as per Annexure – 2

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## 11.2 DOCUMENTS ALONG WITH BID:

The following drawings / documents are to be enclosed along with the bid for scrutiny.

1. Technical write-up giving details of equipment operation, interlocks / control requirement.
2. RO membrane projections (end of 3rd year at 22c, 30 c and 35c).
3. Membrane Datasheet.
4. Preliminary P&I diagram
5. Preliminary skid drawing
6. Filled up data sheets as called in the specification – **Annexure -3 to 5**
7. Utility requirements like instrument air, Electric load requirement.
8. Details called in E, C & I specification.
9. Deviation schedule duly filled, if any –**Annexure – 6**. Any deviation should have cost of withdrawal for our evaluation in the commercial bid.
10. Typical Quality Plan.
11. Un priced commercial offer on the scope of supply
12. Un priced commercial offer for the recommended spares list

### Note:

In case of any deviation, the Bidder shall indicate the deviation, clause by clause in the deviation format attached in **Annexure - 6**. If there is no deviation “NIL” statement shall be furnished. In the absence of the non attachment of this **Annexure-6**, it will be construed that the bid confirms strictly to the specification.

## 11.3 DOCUMENTS AFTER ORDER

The following documents/Drawings and data to be furnished for BHEL / customer approval/information

### Phase-I (for approval) within 3 weeks days from the date of LOI:

1. Technical Write-up and design basis
2. Process Flow Diagram
3. P&ID diagram including pipe sizes & terminal points.
4. Layout showing building details, headroom, equipment.
5. Preliminary GA drawings of the equipment
6. Preliminary Foundation details for the supplied equipment's
7. RO Membrane projections
8. Filled up datasheets for approval as per **Annexure – 2**
9. Preliminary electrical load list

|                                                                                   |                                                                          |                          |
|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------|--------------------------|
|  | <p style="text-align: center;">SPECIFICATION FOR<br/>RO SYSTEM (ETP)</p> | <p>SPEC.NO.ROS: 6170</p> |
|                                                                                   |                                                                          | <p>REV.: 00</p>          |

10. RO system “Control Description” write-up including operation, controls, interlocks, protection, annunciation etc.

**Phase-II (for approval) within 5 weeks from the date of LOI:**

1. Detailed construction and cross-sectional drawings of skids and 3D plant.
2. Detailed assembly & cross sectional drawings for pumps and motor with bill of materials.
3. Pumps performance curves
4. Foundation Design details/drawings indicating foundation load data, anchor bolt location, pocket details, floor & trenches etc.
5. Quality Plan and field quality checks, stage inspection etc. for the above equipment & system
6. RO Membrane Guarantee Document.
7. Duly filled data sheets enclosed as per annexure 3-5
8. Instrument schedule.
9. DCS I/O list.

**Phase-III For information & Review (within 8 weeks from the date of LOI):**

1. RO membrane storage procedure before commissioning
2. RO membrane preservation procedure after commissioning
3. Piping and Valves schedule
4. Bidder shall provide necessary erection drawings (isometric piping, drawings for pipe supports etc.) for the requirement under bidder scope.
5. As-built manufacturing drawing of the RO skids frame and equipment, assembly including piping & valve system arrangements with Bill of material (BOM)
6. Isometric drawing of pipe segments.
7. Details of pneumatic actuators
8. Erection Manual indicating
  - a. Erection/installation instructions of equipments.
  - b. Log sheet containing stage check parameters & clearance
  - c. Log sheets for alignment check of pump & motor
  - d. Field quality checks
9. Performance Test procedure
10. All the documents called in Electrical specification.

|                                                                                   |                                                             |                          |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------|--------------------------|
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#### **Phase-IV (for review):**

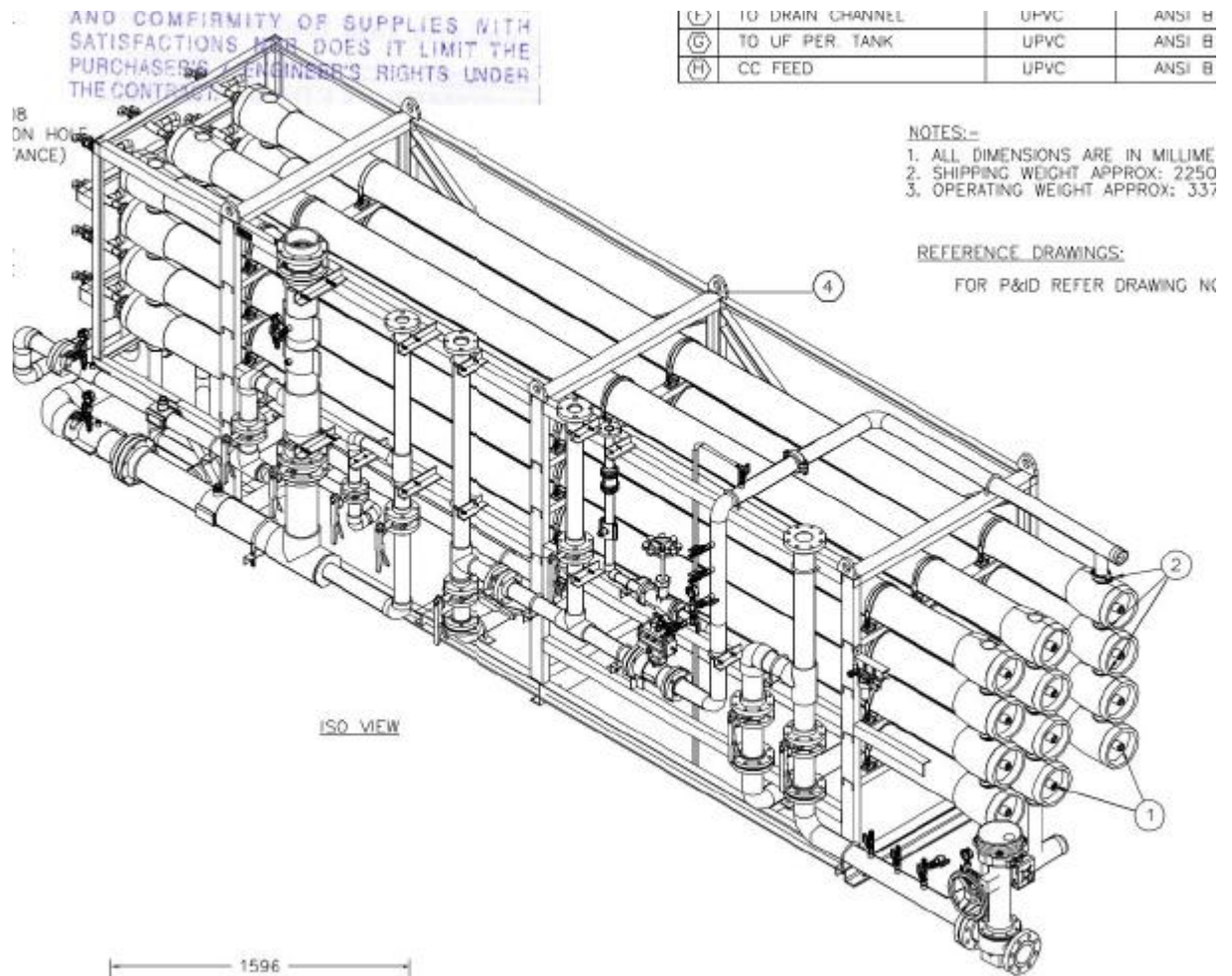
1. Operation and maintenance manual indicating, Operating procedure for start-up, normal operation, chemical cleaning, shut down and emergency shut down.
2. Maintenance instruction & assembly
3. Lubrication chart.
- 5 RO system Logic diagram & Sequential Flow Chart (SFC) for DCS
- 6 Cable interconnection diagram for cables up to junction box & cable schedule.
- 7 Test Certificates for all the supplied instruments.
- 8 List of alarm, interlock & trip set points
- 9 Installation drawings for instruments
- 10 Wiring drawings & GA drawings for Local Panels, junction boxes.
- 11 As built drawings
- 12 All other details called in Electrical specification.

## **12.0 ATTACHMENTS**

**The following drawings enclosed are a part of the specification:**

- |                                  |   |                       |
|----------------------------------|---|-----------------------|
| 1. PID for RO system             | : | 1-WT-060-01044 Rev:00 |
| 2. Equipment layout              | : | 1-WT-150-01045 Rev:00 |
| 3. E C&I technical specification | : | ROS : 4172            |
| 4. Vendor list                   | : | Annexure- I attached  |

## 12.1 Typical RO skid:





|                                                                                   |                                      |                   |
|-----------------------------------------------------------------------------------|--------------------------------------|-------------------|
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### Annexure-1

## GUARANTEE DATA SHEET

### I PERMEATE WATER QUALITY : RO STAGE-1

| <i>Sl.No.</i> | <i>Description</i>               | <i>Unit</i> | <i>Values</i> |
|---------------|----------------------------------|-------------|---------------|
| 1             | Total Dissolved solids           | ppm         | < 80          |
| 2             | Total Permeate output per stream | cu.m / hr   | 45            |

### II MEMBRANE LIFE GUARANTEE

| <i>Sl.No.</i> | <i>Description</i>        | <i>Unit</i> | <i>Values</i>                                             |
|---------------|---------------------------|-------------|-----------------------------------------------------------|
| 1             | Life of Membrane elements | years       | <b>Three years<br/>from the date of<br/>commissioning</b> |

|                                                                                   |                                              |                   |
|-----------------------------------------------------------------------------------|----------------------------------------------|-------------------|
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## Annexure-2

### ELECTRICAL POWER CONSUMPTION

| Sl.<br>No. | Equipment Description                        | Qty |    | Drive<br>rating<br>KW | Conn<br>load.<br>Load<br>KW | Power<br>consumption<br>KW** | Voltage,<br>Phase |
|------------|----------------------------------------------|-----|----|-----------------------|-----------------------------|------------------------------|-------------------|
|            |                                              | W   | SB |                       |                             |                              |                   |
| <b>A</b>   | <b>FOR CONTINUOUS<br/>OPERATING EQPT.</b>    |     |    |                       |                             |                              |                   |
| 1          |                                              |     |    |                       |                             |                              |                   |
| 2          |                                              |     |    |                       |                             |                              |                   |
| 3          |                                              |     |    |                       |                             |                              |                   |
| 4          |                                              |     |    |                       |                             |                              |                   |
| 5          |                                              |     |    |                       |                             |                              |                   |
| 6          |                                              |     |    |                       |                             |                              |                   |
| 7          |                                              |     |    |                       |                             |                              |                   |
|            | <i>Sub total of A</i>                        |     |    |                       |                             |                              |                   |
|            |                                              |     |    |                       |                             |                              |                   |
| <b>B</b>   | <b>FOR INTERMITTENT<br/>OPERATING EQPTS.</b> |     |    |                       |                             |                              |                   |
| 1          |                                              |     |    |                       |                             |                              |                   |
| 2          |                                              |     |    |                       |                             |                              |                   |
| 3          |                                              |     |    |                       |                             |                              |                   |
| 4          |                                              |     |    |                       |                             |                              |                   |
| 5          |                                              |     |    |                       |                             |                              |                   |
|            | <i>Grand Total</i>                           |     |    |                       |                             |                              |                   |

Note:            W – Working            SB – Standby

|                                                                                   |                                      |                   |
|-----------------------------------------------------------------------------------|--------------------------------------|-------------------|
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### **Annexure – 3**

## **EQUIPMENT DATA SHEET FOR RO DESALINATION PLANT**

### **1.0 LOW PRESSURE PUMPS**

: (Recommended CC feed flow & head details shall be provided)

#### **I. TECHNICAL PARAMETERS**

- 1) Make :
- 2) Model :
- 3) Fluid details :
  - Medium handled :
  - PH range :
  - TDS/Chloride range ppm :
  - Temperature range deg.C :
- 4) Rated flow / Head (at Disch) m<sup>3</sup>/hr & mwc:
- 5) Mini. & Max continuous flow m<sup>3</sup>/hr :
- 6) Corresponding discharge Head mwc :
- 7) Shut-off head mwc :
- 8) NPSH required (minimum) mwc :
- 9) Design Pressure kg/cm<sup>2</sup> :
- 10) Hydraulic test pressure kg/cm<sup>2</sup> :
- 11) Pump efficiency at duty point % :
- 12) BKW reqd. for pump at duty point kw :
- 13) Maximum KW required kw :
- 14) Recommended Motor KW kw :
- 15) Rated speed rpm :
- 16) Noise level at duty range dbA :
- 17) Vibration level peak to peak mm :
- 18) Balancing quality :

#### **II. CONSTRUCTION DETAILS**

- 1) Orientation Horizontal / Vertical :
- 2) Suction / Discharge nozzle :
  - Size mm :
  - Rating psi :
  - Orientation :
  - Material :
- 3) Material of Construction / Make :
  - Pump Casing :
  - Impeller :
  - Shaft :
  - Shaft Sleeve :
  - Fasteners :
  - Others if any :

|                                                                                   |                                                                          |                          |
|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------|--------------------------|
|  | <p style="text-align: center;">SPECIFICATION FOR<br/>RO SYSTEM (ETP)</p> | <p>SPEC.NO.ROS: 6170</p> |
|                                                                                   |                                                                          | <p>REV.: 00</p>          |

- 4) No. of stages :
- 5) Impeller type :
- 6) Impeller diameter Trimmed / Untrimmed :
- 7) Bearings :
  - Type :
  - Make :
  - Lubrication oil spec. :
- 8) Performance Curve ref Nos. :
- 9) Pump dimension L x W x H :
- 10) Pump Weight :

### III. COUPLING

- 1) Type :
- 2) Make, Model No. :
- 3) Weight kg :

### IV. BASE FRAME AND ACCESSORIES

- 1) Material :
- 2) Dimension detail mm :
- 3) Weight kg :
- 4) Foundation Bolt - Size & Qty mm & Nos. :
  - MOC :

### V. GENERAL

- 1) Shipping package dimension mm :
- 2) Total Assembly / Shipment weight kg :
- 3) List of Special tools :
- 4) Accessories details :
- 5) G.A. Drawing No. :

|                                                                                   |                                                                          |                          |
|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------|--------------------------|
|  | <p style="text-align: center;">SPECIFICATION FOR<br/>RO SYSTEM (ETP)</p> | <p>SPEC.NO.ROS: 6170</p> |
|                                                                                   |                                                                          | <p>REV.: 00</p>          |

## 1.0 HIGH PRESSURE PUMPS : RO System

### I. TECHNICAL PARAMETERS

- 1) Make :
- 2) Model :
- 3) Fluid details :
  - Medium handled :
  - PH range :
  - TDS/Chloride range ppm :
  - Temperature range deg.C :
- 4) Rated flow / Head (at Disch) m<sup>3</sup>/hr & mwc:
- 5) Mini. & Max continuous flow m<sup>3</sup>/hr :
- 6) Corresponding discharge Head mwc :
- 7) Shut-off head mwc :
- 8) NPSH required (minimum) mwc :
- 9) Design Pressure kg/cm<sup>2</sup> :
- 10) Hydraulic test pressure kg/cm<sup>2</sup> :
- 11) Pump efficiency at duty point % :
- 12) BkW reqd. for pump at duty point kw :
- 13) Maximum KW required kw :
- 14) Recommended Motor KW kw :
- 15) Rated speed rpm :
- 16) Noise level at duty range dbA :
- 17) Vibration level peak to peak mm :
- 18) Balancing quality :

### II. CONSTRUCTION DETAILS

- 1) Orientation Horizontal / Vertical :
- 2) Suction / Discharge nozzle :
  - Size mm :
  - Rating psi :
  - Orientation :
  - Material :
- 3) Material of Construction / Make :
  - Pump Casing :
  - Impeller :
  - Shaft :
  - Shaft Sleeve :
  - Fasteners :
  - Others if any :
- 4) No. of stages :
- 5) Impeller type :
- 6) Impeller diameter Trimmed / Untrimmed :
- 7) Bearings :
  - Type :

|                                                                                   |                                              |                   |
|-----------------------------------------------------------------------------------|----------------------------------------------|-------------------|
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- Make :
- Lubrication oil spec. :
- 8) Performance Curve ref Nos. :
- 9) Pump dimension L x W x H :
- 10) Pump Weight :

### III. COUPLING

- 1) Type :
- 2) Make, Model No. :
- 3) Weight kg :

### IV. BASE FRAME AND ACCESSORIES

- 1) Material :
- 2) Dimension detail mm :
- 3) Weight kg :
- 4) Foundation Bolt - Size & Qty mm & Nos. :  
- MOC :

### V. GENERAL

- 1) Shipping package dimension mm :
- 2) Total Assembly / Shipment weight kg :
- 3) List of Special tools :
- 4) Accessories details :
- 5) G.A. Drawing No. :

## 2.0 CARTRIDGE FILTER ASSEMBLY: ( Separate data sheet shall be filled for RO Stage -1 , RO stage -2 and Chemical cleaning)

### A. HOUSING

#### I. TECHNICAL PARAMETERS

- a. Make :
- b. Model :
- c. Fluid details :
  - Medium handled :
  - pH range :
  - Specific gravity :
  - TDS / Chloride range ppm :
  - Temperature range deg. C :
- d. Rated flow cu.m/hr :
- e. Maximum permitted flow cu.m/hr :
- f. Design Pressure bar(g) :
- g. Test Pressure bar(g) :

|                                                                                   |                                              |                   |
|-----------------------------------------------------------------------------------|----------------------------------------------|-------------------|
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## II. CONSTRUCTION DETAILS OF VESSEL

- a. Vessel Size
- Diameter mm :
  - Thickness
  - Shell mm :
  - Dish end / Cover Plate mm :
  - Cart. Ele. Mounting Plate mm :
  - Straight height mm :
  - Overall height mm :
- b. Capacity to hold no. of cartridges :
- c. Type of cartridge holding arrangement :
- d. Nozzle / End connection
- |                              | Qty | Size | Type | Rating |
|------------------------------|-----|------|------|--------|
| - Inlet                      | :   | /    | /    | /      |
| - Outlet                     | :   | /    | /    | /      |
| - Vent                       | :   | /    | /    | /      |
| - Drain                      | :   | /    | /    | /      |
| - For diff. Press. Indicator | :   | /    | /    | /      |
- e. Orientation of inlet / outlet nozzle :
- f. Flange drilling standard :
- g. Material of construction
- Shell :
  - Cover :
  - Davit :
  - Cartridge holding arrangement :
  - Cover seal :
  - Hand wheel :
  - Fasteners :
- h. Vessel external finish :
- i. Weight of housing
- Empty kg :
  - Loaded kg :

## B. CARTRIDGE ELEMENT

- a. Make :
- b. Model No. :
- c. Material :
- d. Type of end connection / sealing :
- e. Filter loading cu.m/hr/10" cartridge length
- Design :
  - Maximum Allowed :
- f. Filter element rating microns :
- g. Pressure drop
- Guaranteed clean bar(g) :
  - Rec. For element change bar(g) :
  - Maximum permitted bar(g) :

|                                                                                   |                                              |                   |
|-----------------------------------------------------------------------------------|----------------------------------------------|-------------------|
|  | <b>SPECIFICATION FOR<br/>RO SYSTEM (ETP)</b> | SPEC.NO.ROS: 6170 |
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- h. Quantity per filter Nos. :
- i. Element size
- Diameter OD / ID Inch :
- Length Inch :
- i. End seal type & Material :
- j. Weight per cartridge kg :

### C. GENERAL

- a. Drawing No. - Vessel :  
- Internal Arrgts. :  
- Cartridge Element :
- b. Total shipment weight kg :
- c. Shipping size (Lx B x H) Metre : Vessel :  
Element :

### 3.0 GLOBE VALVE – Cage type :

#### I. TECHNICAL PARAMETERS

- 1) Valve sizes :
- 2) Make :
- 3) Model / Type :
- 1) Fluid details
- Medium handled :
- pH range :
- Specific gravity :
- TDS / Chloride range ppm :
- Temperature range Deg. C :
- 5) Rated flow Cu.m/Hr :
- 6) Design Cv of the valve :
- 7) Calculated Cv :
- 8) Valve rating :
- 9) Pressure Drop for rated flow
- At Full Opening Bar :
- During Regulation Bar :
- 10) Design pressure Bar(g) :
- 11) Hydraulic test pressure
- Body Bar(g) :
- Seat Bar(g) :

#### FCV

#### BCV

#### II. CONSTRUCTION DETAILS

- 1) Material of construction
- Body :
- Bonnet :
- Plug :
- Cage :
- Sealing Ring :



|                                                                                   |                                              |                   |
|-----------------------------------------------------------------------------------|----------------------------------------------|-------------------|
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- Stem :
- Gland :
- Gland Flange :
- Gland Packing :
- Gasket :
- Yoke Bush :
- Hand Wheel :
- Fasteners :
- 2) End Connection / Rating / Standard :
- 3) No. Of turns for 100% opening from  
Closed position :
- 2) Total assembly weight Kg :

### III GENERAL

- 1) Applicable standards :
- 2) Drawing No. - Assembly :
- Cross sectional :
- 3) Valve regulation curve No. :

## 4. Manually / Pneumatic operated Butterfly valves

### I. TECHNICAL PARAMETERS

- a. Make :
- b. Model / Type :
- h. Fluid details :
  - Medium handled :
  - pH range :
  - Specific gravity :
  - TDS / Chloride range ppm :
  - Temperature range Deg. C :
- d. Rated flow Cu.m/Hr :
- e. Cv of the valve :
- f. Valve rating :
- g. Pressure Drop ( Maximum) Bar :
- h. Design pressure Bar(g) :
- i. Hydraulic test pressure :
  - Body Bar(g) :
  - Seat Bar(g) :
- j. Max. Shut off Pressure Bar(g) :

### II. CONSTRUCTION DETAILS

#### Material of construction

- Body :
- Disc :
- Seat :
- Stem :

|                                                                                   |                                              |                   |
|-----------------------------------------------------------------------------------|----------------------------------------------|-------------------|
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- Disc Screw :
- Bushing :
- Hand wheel :
- Gear Box – Make / Model :
- Lubrication type :
- b. Angle of operation :
- c. Rec. Min. Pipe ID in mm :
- d. Suggested valve support details :
- D. GENERAL
- a. Total assembly weight Kg : (size wise details)
- b. List of special tools :
- c. Applicable standards :
- d. Drawing No. :

**5.0 PRESSURE VESSEL & RO MEMBRANE: ( Membrane data sheet & Membrane projection shall be submitted)**

- | <b>RO-MEMBRANE ELEMENT</b>                    | <b>Membrane Type#</b> |
|-----------------------------------------------|-----------------------|
| a. Make :                                     |                       |
| b. Model :                                    |                       |
| c. Type/Material :                            |                       |
| d. Quantity offered per stream :              |                       |
| e. Quantity offered as total :                |                       |
| f. Array :                                    |                       |
| g. Life of membrane Years :                   |                       |
| h.                                            |                       |
| i. Total Recovery % : 85                      |                       |
| j. Feed temperature Design/Min/ Max : / /     |                       |
| k. Feed TDS Design/ Min/ Max : / /            |                       |
| l. Feed pressure for design TDS               |                       |
| - Start-up Design temperature Deg. C bar(g) : |                       |
| - End of membrane life Deg. C bar(g) :        |                       |
| m. Maximum allowable pr. to Membrane bar(g) : |                       |
| n. Feed Flow rates Min./ Max. Cu.M/hr : /     |                       |

|                                                                                   |                                              |                   |
|-----------------------------------------------------------------------------------|----------------------------------------------|-------------------|
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- o. Brine Flow rates Min./ Max. Cu.M/hr : /
- p. Maximum permitted pressure drop : bar  
for the above operating conditions
- q. Maximum permeate back pressure Normal : bar  
Maximum : bar
- r. Maximum permitted temperature Deg.C : /  
for membrane
- s. Minimum permitted temperature Deg.C : /  
for membrane
- t. Average flux rate Design/Maximum l/m<sup>2</sup>/hr : /
- u. Lead element flux rate Design/Max. l/m<sup>2</sup>/hr : /
- v. Salt Rejection-Minimum/Nominal % : /
- w. Standard Test Conditions :
- x. Operating pH range :
- y. Allowable SDI Maximum SDI<sub>15</sub> :
- z. Maximum allowable organic loading  
- TOC ppm :  
- BOD ppm :  
- COD ppm :
- aa. Flux decline coefficient/year % :
- bb. Salt passage increase Factor(SPIF)/Year :
- cc. Membrane projections-Reference :
- dd. Guarantee document-Reference :
- ee. Weight per element Kgs :
- ff. Recommended pressure-vessel make :
- gg. Recommended pressure rating (psi) :

## 6.0 PRESSURE VESSEL

- a. Make :
- b. Model :
- c. Material of construction - Pressure vessel :  
- End Plate :

|                                                                                   |                                                             |                   |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------|-------------------|
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- End adapters :
- Interconnector :
- Holding strips :
- Support saddle :
- O rings :
- Feed & Brine port :
- Permeate port :
- d. Quantity of pressure vessels offered set :
- e. Pressure rating psi :
- f. Design Pressure psi :
- g. Test pressure psi :
- h. Burst Pressure psi :
- i. Port size / Orientation
  - Feed : /
  - Brine : /
  - Permeate : /
- j. Port Victaulic Groove Style- Feed :
  - Brine :
  - Permeate :
- k. Empty weight Kgs :
- l. Filled weight Kgs :
- m. Shipment weight Kgs :
- n. Vessel Drawing No. :

|                                                                                   |                                              |                   |
|-----------------------------------------------------------------------------------|----------------------------------------------|-------------------|
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**Annexure – 4**

**VALVE SCHEDULE – DATA SHEET TO BE FILLED BY THE BIDDER**

| Sl. No. | Service                 | Valve Type | Size | BODY | Disc / Ball / Diaphragm | Stem / Shaft | Valve seat / Seat ring | Hinge Pin | Valve Ends |
|---------|-------------------------|------------|------|------|-------------------------|--------------|------------------------|-----------|------------|
| 1       | <b>Manual valves</b>    |            |      |      |                         |              |                        |           |            |
|         |                         |            |      |      |                         |              |                        |           |            |
|         |                         |            |      |      |                         |              |                        |           |            |
|         |                         |            |      |      |                         |              |                        |           |            |
| 2       | <b>Pneumatic Valves</b> |            |      |      |                         |              |                        |           |            |
|         |                         |            |      |      |                         |              |                        |           |            |
|         |                         |            |      |      |                         |              |                        |           |            |
|         |                         |            |      |      |                         |              |                        |           |            |
| 3       | <b>Check Valves</b>     |            |      |      |                         |              |                        |           |            |
|         |                         |            |      |      |                         |              |                        |           |            |
|         |                         |            |      |      |                         |              |                        |           |            |
|         |                         |            |      |      |                         |              |                        |           |            |

|                                                                                   |                                      |                   |
|-----------------------------------------------------------------------------------|--------------------------------------|-------------------|
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# Annexure-5

## List of **RECOMMENDED SPARES**

| Sl.<br>No. | Description of the equipment | Description of spares | Quantity | Price |
|------------|------------------------------|-----------------------|----------|-------|
|            |                              |                       |          |       |
|            |                              |                       |          |       |
|            |                              |                       |          |       |
|            |                              |                       |          |       |
|            |                              |                       |          |       |
|            |                              |                       |          |       |
|            |                              |                       |          |       |
|            |                              |                       |          |       |
|            |                              |                       |          |       |
|            |                              |                       |          |       |

|                                                                                   |                                      |                   |
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## ANNEXURE-6

### TECHNICAL DEVIATIONS

| <i>Sl. No</i> | <i>Section no.</i> | <i>Clause No.</i> | <i>Page / No.</i> | <i>Specification</i> | <i>Statement of Deviations/variatio</i> | <i>Reason for Deviation</i> | <i>cost of withdrawal</i> |
|---------------|--------------------|-------------------|-------------------|----------------------|-----------------------------------------|-----------------------------|---------------------------|
|               |                    |                   |                   |                      |                                         |                             |                           |
|               |                    |                   |                   |                      |                                         |                             |                           |
|               |                    |                   |                   |                      |                                         |                             |                           |
|               |                    |                   |                   |                      |                                         |                             |                           |
|               |                    |                   |                   |                      |                                         |                             |                           |
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**SPECIFICATION FOR ELECTRICAL,  
CONTROL & INSTRUMENTATION**

**SPEC. NO.: ROS 4172**

**REV. NO: 00**

**TECHNICAL SPECIFICATION FOR  
ELECTRICAL, CONTROLS & INSTRUMENTATION  
(Applicable for Kilwa project)**

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| 00     | 23.06.17 | <i>MKV</i> | <i>MKV</i> | <i>VNS</i> | Fresh issue |
| Rev.No | Date     | Prepared   | Checked    | Approved   | Remarks     |





Climatic conditions in the site area – Plant Ambient Conditions:

- Altitude - 28.95 m Above mean sea level
- Ambient dry bulb temperature - 33°C.
- Relative humidity - 60%.
- Atmospheric pressure - 1.013 bara

## **1.0.0 TECHNICAL REQUIREMENT FOR INSTRUMENTATION**

### **1.1.0 FIELD INSTRUMENTS**

a) Analog outputs signals from field instrumentation to the control systems are 4-20 mA dc signals. Instrumentation can be self-powered, or loop powered from the control systems. Self-powered analog signals shall be true “isolated from ground” signals.

b) Field switches will be micro switch type with auto reset. Switches will have NO and NC contacts. Switch contacts shall be snap acting, 2 Nos of SPDT, hermetically sealed, potential-free with a minimum contact rating of 230 V AC 5A/ 220V DC 0.5A.

c) Transmitters will be used to provide the required 4 to 20mA signals for all controllers and receivers. Transmitters will be of the electronic, two-wire type, capable of driving an output impedance of 600 ohms minimum at 24 V dc, and will be generally powered from the control system I/O cards. All the transmitters supplied shall be SMART type with HART capability.

d) Pressure, DP type flow, differential pressure, DP type level Transmitter accuracy shall be within 0.075% of calibrated span and shall have repeatability of +0.1% of span or better. Errors caused by change in ambient temperature shall not exceed 0.01% of span per°C change. Temperature variations of +55°C shall not affect the 0.1% accuracy rating nor the 0.1% repeatability.

e) The plant instrument air supply pressure shall be:

- Maximum supply pressure 7 bar
- Minimum supply pressure 5 bar

g) All instruments and analyzers shall employ EMI, RF protection in the system design.

h) Instrument tags should be permanently attached to the device. If this is not possible, the instrument tag should be fastened to the instrument with stainless steel wire.

j) All instrumentation mounted inside, away from direct exposure to the elements, shall be as a minimum IP-54 construction unless it is in an environmentally controlled environment (e.g the control room). If the instrument is mounted in an environmentally controlled environment the instrument shall be as a minimum IP-32 construction.

k) All instrumentation mounted outside shall be as a minimum IP-65/66 construction. Test certification shall be provided for flow elements / valve / Erection hardware wherever applicable.

l) Transmitters and switches shall be grouped depending on the location. Individual instruments shall be mounted on stanchion or pipe mounted.

m) For saline applications and other applications which are corrosive in nature, the wetted part material to be selected which shall meet the process applications, preferably diaphragm seal to be used.

Hastelloy C wetted part material and SS316L impulse piping / root valve material to be considered for the above applications.

o) The following metric engineering units shall be used for all instrumentation devices :

- Pressure – bar Pressure instrument shall have the unit Suffixed with 'a' to indicate absolute pressure. If nothing is there, that will mean that the indicated pressure is gauge pressure.
- Temperature - °C
- Liquid flow – m<sup>3</sup>/hr
- Differential pressure – bar
- Density – Kg/m<sup>3</sup>

### **1.2.0 MAINTENANCE REQUIREMENT**

1.2.1 To ensure easy maintenance Make of all I&C equipment like control valve, actuator, all electronic transmitters, control hardware, local devices, other instruments etc shall be uniform to the extent possible.

1.2.2 Selection of a particular Make and model of instruments shall be such to permit maximum interchangeability, easy maintenance and repair and to maintain minimum inventory.



1.2.3 Maintenance platforms and access ladders for all the instrumentation equipment installed at inaccessible heights. Sufficient maintenance space shall also be provided against each instrumentation equipment area with safety barricades in the platforms and handrails in the ladders.

1.2.4 Easy access shall be provided for all components in the equipment and system offered to reduce the maintenance period.

1.2.5 Necessary maintenance equipment tools and special erection tools which are not specifically mentioned in the specification but are normally required for ease in maintenance and to have minimum down time, shall be included in the Bidder's scope.

1.2.6 Standardization concept shall be used in selecting the components for the systems.

1.2.7 Provision shall be made for isolating sub-systems/modules, which are identified to be faulty, thus enabling on-line replacement without taking equipment off-line.

1.2.8 All the documentation shall be in English Language.

### **1.3.0 AVAILABILITY REQUIREMENT**

1.3.1 Adequate redundancy shall be built in at various levels to increase the system availability and reliability.

1.3.1 To ensure high reliability of the trip circuit and to avoid spurious tripping of the plant, multiple input logic system, (e.g., 2 out of 3 logic) shall be provided for important and vital trip functions. **This shall be decided during detailed engineering.**

1.3.3 Control valves/dampers shall be driven to the fail safe position or hold position in case of control system failure, as required. This arrangement is necessary to avoid system upsets and subsequent loss of operation.

### **1.4.0 CODES AND STANDARDS**

The design & specification of I&C system will be in accordance with the applicable laws, State local codes, ordinances and industry standards applicable to design and construction as indicated below.

- ☐ American Gas Association (AGA)
- ☐ American National Standards Institute (ANSI).
- ☐ American Society of Mechanical Engineers (ASME).
- ☐ The Institute of Electrical and Electronics Engineers (IEEE).
- ☐ Deutsche Industries Normen (DIN)
- ☐ Instrumentation Systems and Automation Society (ISA).
- ☐ National Electrical Manufacturers Association (NEMA).
- ☐ National Fire Protection Association (NFPA)
- ☐ Scientific Apparatus Makers Association (SAMA).
- ☐ Indian Standards (IS)
- ☐ International Standards Organization (ISO)
- ☐ British standards (BS)
- ☐ International electro technical committee (IEC)
- ☐ American petroleum Institute (API)

Other recognized equivalent international standards will be utilized as required to serve design, fabrication, and construction guidelines when not in conflict with the above listed standards. Such acts of the Bidder shall be brought to the Employer / Engineer notice before proceeding with the same.

#### **1.4.1 TEMPERATURE MEASUREMENT**

- ☐ Instrument and apparatus for temperature measurement - ASME PTC 19.3 (1974)
- ☐ Temperature Measurement Thermocouples – IEC 60584 – 3 / ANSI - MC 96.1 (1982)
- ☐ Thermometer-element-Platinum resistance – IEC 751 / DIN 43760 / IS2848
- ☐ Temperature measurements – BS1041

#### **1.4.2 PRESSURE MEASUREMENT**

- ☐ Instrument and apparatus for pressure measurement - ASME PTC 19.2(1987)
- ☐ Instrument Accuracies - IS 3624 / ASME
- ☐ Process operated switch devices (Pressure switch) - BS6134
- ☐ Pressure gauges – IS – 3624,1987



□□Electronics Transmitters – BS6447

#### **1.4.3 FLOW MEASUREMENT**

□□Instruments and apparatus for flow measurement (Flow nozzle assembly)- ASME PTC 19.5 (1972) Interim supplement, Part-II, BS 1042.

□□Instruments and apparatus for flow measurement (Orifice plate)- ISO 5167 Part – 1 / BS 1042.

#### **1.4.4 ELECTRONIC MEASURING INSTRUMENTS AND CONTROL HARDWARE**

□□Automatic null balancing electrical measuring instruments - ANSI C 39.4 .

□□Safety requirements for electrical and electronic measuring and controlling instrumentation - ANSI C 39.5 / 1974.

□□Compatibility of analog signals for electronic industrial process instruments ISA-S 50.1: ANSI MC 12.1.

□□Dynamic response testing of process control instrumentation - ISA -S26.

□□Surge withstands capability (SWC) tests - ANSI C37.90.1-1989 / IEC-255-4.

□□Electro-Magnetic Compatibility Tests – IEC 61000

□□Tests for electronic equipments – IEC 68

□□RF compatibility standard-IEC

□□Control Procedure for data communication system – ISO 1745

#### **1.4.5 ENCLOSURES**

□□Classification of hazardous area – IEC 79

□□Degree of protection for enclosures – IEC 60529.

□□Electrical Instruments in Hazardous Area – ISA RP 12.11

□□Environmental conditions for process measurement and control systems – ISA S71.04

#### **1.4.6 SAMPLING SYSTEM**

□□ASME PTC 19.11 Steam and Water Sampling, Conditioning, and Analysis in the Power Cycle.

□□ASME PTC 19.10 Flue gas Sampling.

#### **1.4.7 INTERLOCKS, PROTECTIONS, SYMBOLS**

□□Turbine water damage prevention - ASME-TDP-1.

□□Boiler safety interlocks – Applicable NFPA 85 sections.

□□Instrumentation Symbols And Identification– ISA – S5.1.

□□Binary logic diagrams for process operations – ISA – S5.2.

□□Graphic symbols for distributed control/shared display instrumentation – ISA – S5.3

#### **1.4.8 ANNUNCIATORS**

□□Specifications and guides for the use of general-purpose annunciators - ISA RP 18.1.,ISA-S19.1,(1974)

#### **1.4.9 CONTROL VALVES**

□□Control Valve Sizing - ISA-75.01.

□□Control Valve capacity test - ISA-75.02.

□□Face to face dimensions of Control Valves - ANSI B16.10.

□□Control valve seat leakage classification – ANSI / FCI 70.2

□□Valves flanged threaded and welding end - ASME B 16.34

#### **1.4.10 CABLES**

□□Thermocouple extension wires / cables - ANSI MC96.1.

□□Colour coding of Instrument cables - BS-5308, Part-2.

□□Specification for PVC insulated cables – IS 5831 / 8130/ 1554/ 10810 / equivalent IEC standards.

□□Guide for design and installation of cable system in power generating station (insulation, jacket materials) IEEE Standard 422 / NEMA VE-1, and NEC.

□□FRLS tests - IEC 332 / IEC 754 / IEEE 383 / SS-4241475 / ASTM D2863/ 43

□□Requirements of vertical tray flame test - IEEE 383.

□□NFPA 72 – National fire alarm code (Latest edition)

#### **1.4.11 OTHER STANDARDS**

a. IEC 146 Performance Testing of UPS.

b. IS 10918-1984 Specification for vented type Nickel Cadmium Batteries.

c. ANSI C 34.2, 1973 Practices and requirements for semiconductor power rectifiers.



- d. ISA RP 55.1 1982/ Hardware testing of digital computer. ANSI MC8.1 1975
- e. IEEE - 830, 1998 IEEE guide to software requirement specifications.
- f. ANSI C 39.5-1974 Safety requirements for electrical and electronic measuring and controlling instrumentation.
- g. IEEE STD 1115 Recommended Practice for sizing Nickel Cadmium Batteries for Stationary Applications.
- h. IS-2147-1962 Protection class for Enclosures.
- i. ISO/R 541 Orifice Plate
- j. ASTM-B-33-81 Standard specification for tinned soft or annealed copper wire for electrical purpose.
- k. VDE 0815 Wiring cables for telecommunication and information processing system.
- l. VDE 0207m. VDE 0472 Rules for Testing insulated cables and Flexible cords.
- n. NEMA VE-1, IEEE 422 Guide for the design and installation of cable system in power generating station (cable trays, support system, conduits, test standards etc.)
- o. IEC 754-1 Acid gas generation test
- p. ASTM - D - 2843 Smoke generation test
- q. SEN - 4241475 (F3) Swedish chimney test
- r. ASTM D 2116 Teflon (FEP) insulation & sheath Tests.
- s. IS 8784 Thermocouple compensating cables - Testing requirements & sampling plan
- t. NFPA 70-1984 Classification of hazardous area. Art 500 Vol.6
- u. NEC/USA Classification of hazardous area Art 500 1978
- v. ANSI B 133.4, Gas Turbine Control & Protection System 1978 (R 1990)
- w. API 614 Control system for Gas Turbines
- x. DIN 33414 Ergonomically design of control room. Part 2 Cognitive factors Part 4 Arrangement of Principles.
- y. VGB 117C Protection systems DIN 51116
- z. DIN 4551, 4552, 33402, 33406 -Anthropometric Design
- aa. VDI 2780 Anthropometric Design
- bb. DIN 33400, 33405, 33407- Ergonomic Design
- cc. VDI 2224 - Ergonomic Design
- dd. DIN 18228 - Health Aspects
- ee. DIN 33403 - Environment
- ff. DIN 45645, VDI 2058 - Noise
- gg. VDE/VDI 3546 - Control Room Design
- hh. VDE 0801 - Safety System

#### **1.4.12 ELECTRIC MOTORS**

- a. IEC 60034 : Specification for rotating machines.
- b. IEC 60079 : Electrical apparatus for Explosive gas atmospheres
- c. ANSI/UL-674 : Electric Motors and Generators for use in Hazardous location, Class-I Groups C & D, Class-II, Groups E, F & G.

Motors shall also confirm to other applicable standards amended up to date.

#### **SPECIFICATION FOR LT MOTORS**

#### **2.0.0 TECHNICAL REQUIREMENTS**

##### **Design Margin Criteria**

The drive motor rating shall be selected such that a minimum margin requirement is available over the pump input power required at the rated duty point. However, motor rating shall not be less than the maximum power required by the pump at any point on the curve including the run-off condition.

- 25% upto 18.5KW,
- 15% for 22-55KW,
- 10% for above 75 KW



### **2.1.0 Motors Design Features**

All AC motors shall be squirrel cage three phase/ single phase induction motors. All motors shall be rated for continuous duty except for crane motors be rated for intermittent duty. All Motors shall be designed for direct on line starting at full voltage.

1. The motor rating shall be at least 10% over the maximum input power requirement of the driven equipment at rated point.
2. Motors shall be of High efficiency type (IE 3) with high power factor (at least 0.8).
3. Power supply for AC motors shall be as follows:
  - Below 0.2 kW : 230 V, 1 Phase, 50 Hz.
  - From 0.2 kW and upto 200 kW : 415 V/400 V,  $\pm 10\%$ , 50Hz,  $\pm 5\%$ , 3phase.
4. Motors shall be capable of delivering the rated output with supply voltage variation of  $\pm 10\%$  and frequency variation of  $\pm 5\%$  and absolute sum of 10%.
5. The motor characteristics shall match the requirements of the driven equipment so that adequate starting, accelerating, pull up, breakdown and full load torques are available for the intended service.
6. Squirrel cage induction motors shall be designed for direct on line starting. Starting current shall be as specified in the IEC 60034.
7. The motor shall be capable of withstanding the stresses imposed if started at 110% rated voltage. Motor shall start with rated load and accelerate to full speed with 80% rated voltage at motor terminals. Permissible number of starts per hour for continuous duty motors shall be as follows.
8. No. of hourly startups uniformly distributed, starting from final steady working temperature (Hot) - Three.
9. No. of consecutive startups with initial temperature of motor at final steady working temperature (Hot)- Two
10. Motors subject to reverse rotation shall be designed to withstand the stresses encountered when starting with non-energized shaft rotating at 125% of rated speed in reverse direction.
11. The locked rotor withstand time under hot condition at 110% rated voltage shall be more than motor starting time by at least 2.5 seconds for motors with 20 seconds starting time and by 5 seconds for motor with more than 20 seconds starting time. Starting time shall be at the minimum permissible voltage of 80% rated voltage.
12. Motors required to operate on part load shall be VFD controlled with wide frequency range operation.

### **2.2.0 Motor Constructional details**

1. All Motors located indoor & outdoor shall have IP 55 degree of protection for the enclosure. For vertical mounted outdoor motors a Canopy shall be provided.
2. The motors shall generally be of self ventilated type totally enclosed fan cooled (TEFC).
3. The winding for all the motors shall be of super enameled copper wire of suitable gauge or copper strip conductor depending on its rating. All motors shall be class F insulated limiting temperature rise to class B limit.
4. The windings, fittings and hardware shall be corrosion resistant. The windings shall be tropicalised and shall be impregnated to make them non-hygroscopic and oil resistant. Main insulation and inter turn insulation of Motors shall be capable of withstanding switching surges as per IEC 34, Part 15.
5. Motors of rating 30 kW and above shall be provided with space heaters, suitably located for easy removal or replacement. The space heater shall be rated for 230 V, single phase, 50 Hz, and sized to maintain the motor internal temperature above dew point when the motor is idle.
6. Motor shall be provided with antifriction bearings, unless sleeve bearings are required by the motor application. Vertical shaft motors shall be provided with thrust and guide bearings. Thrust bearing of tilting pad type are preferred.



7. Bearings shall be provided with seals to prevent leakage of lubricant or entrance of foreign matters like dirt, water etc. into the bearing area.
8. Motor terminal boxes shall be provided with a detachable extension box (cable core splitter box). Terminal box shall be capable of being turned 360° in steps of 90°, unless otherwise approved. The terminal boxes shall be split type with removable cover with access to connections and shall have the same degree of protection as motor. The terminal box shall have sufficient space inside for termination/connection of cables.
9. Terminals shall be of stud type, substantially constructed and thoroughly insulated from the frame. The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor. The terminal box shall be capable of withstanding maximum system fault current for 0.25 sec for all breaker operated motors and shall be provided with explosion vent. However for contactor operated motors, the terminal box shall be capable of withstanding fault current for let through time of the fuse/MCCB/MCB preceding it.
10. All accessory equipment such as space heater temperature detector, etc., shall be wired and terminated in a enclosure, separate from motor (power) terminal box. The degree of protection for accessory terminal box shall be same as that of motor. Terminal box shall be complete with double compression brass glands and stud type terminals and shall be suitably mounted on the side of the motor. If possible, the accessory terminal boxes shall be located on the same side of the motor as the main (power) terminal box.
11. The noise level and vibration limits shall not exceed the limits specified in relevant IEC standards.
12. The frame of each motor shall be provided with two separate and distinct grounding pads complete with tapped hole, GI bolts and washer. The cable terminal box shall have a separate grounding terminal.
13. The grounding connection shall be suitable for accommodation of following sizes of earthing materials.
  - LT motors rated above 90KW : 150 sq.mm Cu.
  - Motors above 30kW and up to & including 90kW : 95 sq.mm Cu.
  - Motor Cable Terminal box, LPB station : 10 sq.mm Cu.

### **3.0.0 PRESSURE INSTRUMENTATION (Pressure transmitters & Differential Pressure transmitters Pressure gauges & Pressure switches)**

Scope of supply:

- Pressure Transmitter, SS316 tubing with 2 valve manifold, SS316 isolation valve, fittings and mounting accessories.
- Pressure Switch, SS316 tubing with 2 valve manifold, SS316 isolation valve, fittings and mounting accessories.
- Pressure Gauge, SS316 tubing with 2 valve manifold, SS316 isolation valve, fittings and mounting accessories.
- Differential Pressure Transmitter, SS316 tubing with 5 valve manifold, SS316 isolation valve, fittings and mounting accessories.
- Differential Pressure switch, SS316 tubing with 5 valve manifold, SS316 isolation valve, fittings and mounting accessories.
- Differential Pressure gauge, SS316 tubing with 5 valve manifold, SS316 isolation valve, fittings and mounting accessories.



## SPECIFICATION FOR ELECTRICAL, CONTROL & INSTRUMENTATION

SPEC. NO.: ROS 4172

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Pressure, DP type flow, differential pressure accuracy shall be within 0.075% of calibrated span and shall have repeatability of +0.1% of span or better. Errors caused by change in ambient temperature shall not exceed 0.01% of span per°C change. Temperature variations of +55°C shall not affect the 0.1% accuracy rating nor the 0.1% repeatability.

- a. Pressure transmitters are electronic, 24 VDC analog 2-wire transmitters with 4-20mA dc output signals.
- b. Pressure transmitters will be supplied with integral mounted two valve manifolds.
- c. All pressure transmitters shall be capable of withstanding their body rating conditions without permanent damage or loss of calibration.
- d. Differential pressure transmitters shall be capable of withstanding a differential pressure equal to full process pressure on either side of the measurement element without damage or loss of calibration.
- e. Differential pressure transmitters will be supplied with integral mounted three valve manifolds for air service and 5 way valve manifold for steam & water service.
- f. Pressure gauges will be generally 150mm dial, solid front safety case type with blowout back, 1/2" NPT bottom connection, drawn stainless steel case, 316SS bourdon and socket, stainless steel movement, micrometer pointer. Pulsation dampers will be provided for pulsating pressure services. Liquid filled gauges shall be used for all pump discharges, vibrating or pulsating services.
- g. Pressure switches will generally be snap acting type, DPDT action, with individual "on" and "off" points to be on a calibrated scale or dial.
- h. Dual type control switches such as pressure switches having two sets of contacts with independently adjustable set points shall not be used where set point adjustment and dead band are a problem (e.g. low pressure and vacuum applications). If a potential problem exists, two single purpose switches shall be used. Switch differential shall be adjustable.
- i. The indicating type switches are not acceptable. If application requires indication and switching function, then a separate blind switch and a gauge to be used.
- j. The pressure gauges shall have  $\pm 1\%$  accuracy and over range protection of 150%.
- k. Condensate pots for pressure transmitters and siphons for gauges shall be used for steam and high temperature applications. Chemical seals to be used for highly corrosive and viscosity applications
- l. The switches shall have the following:
  - Contact rating : 230V AC, 5A / 220V DC 0.5A.
  - Repeatability :  $\pm 0.5\%$  FSR

### 3.1.0 TEMPERATURE INSTRUMENTATION (RTD, Thermocouple, Thermowell, Temperature transmitter, Temperature switches, Temperature gauges)

Scope of supply:

- Temperature Transmitter with mounting accessories.
- Temperature Switch, SS316 thermowell, capillary fitting and mounting accessories.
- Temperature Gauge, SS316 thermowell, capillary fitting and mounting accessories.

Temperature transmitter accuracy shall be within 0.075% of calibrated span and shall have repeatability of +0.1% of span or better. Errors caused by change in ambient temperature shall not exceed 0.01% of span per°C change. Temperature variations of +55°C shall not affect the 0.1% accuracy rating nor the 0.1% repeatability.

- a) For temperature up to 300°C 3-wire RTD duplex type, PT 100 type shall be used. For temperature beyond 300°C thermocouples shall be used. Thermocouples shall be manufactured in accordance with the ISA Standard MC96.1, Temperature Measurement Thermocouples. All thermocouples shall be Chromel Alumel (Type K) for 300°C < T < 850°C. R or S type for T > 850°C.
- b) The RTD/Thermocouple signal shall be converted into 4~20mA in the field and shall be used as input to DCS. However, The mV signal of thermocouple/RTD shall be used as input to the DCS. Cold junction compensation shall be achieved in the DCS, where it is not exceeding the 50 meters distance like GTG to Electric package.



- c) Thermocouples shall have duplex elements and ungrounded measuring junction.
- d) An extension nipple / union / nipple of sufficient length to extend beyond lagging and connection head shall be furnished for each thermocouple assembly. Terminal blocks shall be marked with polarity and connectors shall be resistant to heat, vibration and galling. The cap shall provide a weather tight enclosure and a chain shall be provided to prevent loss of cap. The cap shall be made of cast aluminium.
- e) RTDs of Duplex type furnished by the Supplier shall be of the three-wire type made with 100 ohm platinum resistance elements. They shall be certified to meet the requirements of the International Temperature Scale, calibrated to the IEC-751 standard ( $\alpha = 0.00385 \text{ Ohms/Ohm/}^{\circ}\text{C}$ ), and be guaranteed to an accuracy to within  $\pm 1.1^{\circ}\text{C}$  of this standard. The RTDs shall be contained in an insulated material and a sheath or sleeve of stainless steel SS-316 and shall be so mounted that they can withstand the greatest shocks and vibrations that can be imposed upon them in the system piping without deterioration. Specific information shall be furnished concerning type and accuracy of bridge circuits to be used with the RTDs. RTDs shall be directly connected to DCS without any transmitters. Response time of RTD with thermo-well shall be 30 sec or better.
- f) Unless specified otherwise, each temperature element and thermometer shall be provided with a 1" socket weld type, 316 stainless steel tapered thermowell suitable for the requirements of the given application. Temperature element process connection shall be  $\frac{1}{2}$  NPTM.
- g) Temperature transmitters are to be provided for all temperature measurements that are used in any CLCS. For thermocouple, cold junction compensation shall be implemented within the transmitter.
- h) Thermocouples will be of duplex MI type in ISA, K (chromel-Alumel), Platinum- Rhodium/Platinum with sheath OD 6 mm. RTD will be Duplex, Pt 100 ohm, 3 wire type as per DIN standard 43760 or equivalent. Thermo wells will be ASME PTC 19.3 latest revision with process connection M 33x2 for threaded connection and flanged connection for Air and Gas system & tanks; accuracy will be  $\pm 0.5$  percent or better.
- Response time of thermocouple with thermo-well shall be 30sec or better.
- i) Thermowell immersion length will generally be between  $\frac{1}{3}$  and  $\frac{1}{2}$  the distance to the center of the pipe. Where thermo wells are installed in lines smaller than 4 inches, the piping shall be expanded to 4 inch size to accommodate the thermo well. Thermowell shall be drilled from solid bar stock.
- j) All thermo well in a high velocity line or duct shall have an ASME PTC 19.3 calculation for determination of the wells resonant frequency. Thermo wells that do not meet the acceptance criteria shall be resized or relocated as necessary.
- k) Thermocouple extension wire is to be solid, shielded, twisted pairs.
- l) If intermediate terminal blocks are required in a thermocouple measuring circuit, they need not be the same material as the thermocouple.
- m) Dial thermometers shall be bimetallic, minimum 150mm dial, every angle form, hermetically sealed with external recalibration adjustment,  $\frac{1}{4}$ " OD SS stem,  $\frac{1}{2}$ " NPT connection and SS case.
- n) Temperature switches shall be actuated by filled bulb-type elements equipped with standard-length armored capillary tubing. Electronic temperature switches shall be supplied, where it exceeding the temperature of  $400^{\circ}\text{C}$ .
- o) Temperature gauges shall have  $\pm 1\%$  accuracy and overage protection of 125%.
- p) Switches shall have the following:  
Max. contact rating : 230V AC, 5A  
Repeatability :  $\pm 0.5\%$  FSR  
Contact type : snap acting

### **3.2.0 FLOW INSTRUMENTATION**

Scope of supply:

- Differential Pressure Flow/Level Transmitter, SS316 tubing with 5 valve manifold, SS316 isolation valve, fittings and mounting accessories.





Pressure, DP type flow, differential pressure and other miscellaneous transmitter accuracy shall be within 0.075% of calibrated span and shall have repeatability of +0.1% of span or better. Errors caused by change in ambient temperature shall not exceed 0.01% of span per°C change. Temperature variations of +55°C shall not affect the 0.1% accuracy rating nor the 0.1% repeatability.

a. Flow nozzles will be used for main steam flow, feed-water flow and other critical measurements where weld-in construction is required. Orifice plates will be used for other liquid flow measurements where flanged construction is acceptable. Accuracy of the measuring orifice plates, nozzles, venturi's and annubar shall be minimum  $\pm 1\%$ . Ultrasonic type flow meter shall be used for cooling water flow application with an accuracy of minimum  $\pm 0.4\%$  of measured flow or better and haste alloy C wetted part material to be used if insertion type is provided.

b. Flow elements will be accompanied by Test certification.

c. Flow nozzles and orifice plates shall conform to requirements of ASME "Fluid Meters".

d. Flow nozzles shall be of the weld-in holding ring type ASME long radius, with dual wall taps and shall be of stainless steel. Flow nozzles shall be furnished complete with metered runs in accordance with ASME PTC 6.1. Metered pipe run and nozzle shall match the pipe material and size that metered section is to be installed in.

e. Orifice plates shall be 316SS, sharp square edge thin plate, and paddle type suitable for installation between raised face orifice flanges. Orifice flanges, gaskets and jacketing screws shall be furnished by the Supplier. Paddle shall be stamped with the orifice ID bore diameter on the upstream side. Orifice flanges will be of the raised face, weld-neck type with dual 2 sets of taps as required for redundancy.

f. Beta ratios shall be between 0.3 and 0.7. Flow elements (flow nozzle & orifice) sizing shall as per BS-1042/ISO-5167.

g. Differential type flow transmitters shall be supplied with three valve manifolds directly mounted to the transmitter for gas applications and five valve manifolds directly mounted to the transmitter for steam and liquid applications

h. Differential type flow transmitters shall be electronic, analog 2-wire transmitters with 4-20 mA dc output signals.

i. Square root extraction of the flow signal is performed in the instrument..

j. Ultrasonic flow meters / coriolis mass flow meter to be used for custody transfer of natural gas as per the AGA standards with accuracy of minimum 0.2 % of measured flow.

k. The flow sight glass shall be of rotary type with tempered glass, carbon steel body and bronze wetted parts.

l. Variable area flow indicators to be provided at the common outlet header of the identical equipment, CW blow-down etc. Carbon steel body with SS 316 float and scale shall be provided. Accuracy shall be minimum  $\pm 2\%$  or better.

m. Flow switches to be provided at the common outlet header of the identical equipment. Carbon steel body with SS 316 element and contacts shall be provided.

### **3.2.1 PADDLE WHEEL FLOW TRANSMITTER**

Scope of supply:

- Flow Sensor, Transmitter display, Sensor to transmitter cable, saddle fitting or strap on fitting and standard mounting accessories.

1 Flow Sensor:

- a) Type : Paddle Wheel, On-line.
- b) Installation fitting Type : Saddle / Strap on fitting depending on line size.
- c) Sensor Length : To suit the corresponding pipe line size.
- d) Cable length from sensor to transmitter : Min 5m (Integral with sensor/ separate)

2 Transmitter

- a) Type : 2 wire type, with separate remote mounted LCD display unit.
- b) Scale range, Cu.m./ Hr : As per process requirement.



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- c) Mounting : Skid/Wall mounted type with mounting accessories  
d) Protection : IP 55, weather proof.  
e) Power supply : 24 V DC +/- 10%  
f) Accuracy :  $\pm 1\%$  of full scale.  
g) Output Signal : 4-20mA DC

### 3 Sensor fitting

- a) Type : Metal Strap-on saddle for GRP pipes  
PVC – Saddle for UPVC pipes above DN 50 and upto DN 200, True union fitting for UPVC pipes upto DN 50.

### 3.2.1 ELECTROMAGNETIC FLOW TRANSMITTER

#### Scope of supply:

- Flow Sensor tube flanged, Transmitter display, Sensor to transmitter cable, grounding rings and mounting accessories.

a. Primary element of the Electromagnetic flow meter shall have a flanged metallic tube with a non conductive liner. The tube and Flange material shall be SS316L. The tube liner material shall be PTFE, compatible with the process fluid. Liner shall be extended over the full width of the flange face to the bolt circle. Liner thickness shall be selected to suit the application.

b. Electrode material / shred material shall be best suited to the fluid, to minimize corrosion or abrasive wear. Electrode shall be of self cleaning type. Recessed electrode faces are not acceptable.

c. The coil house shall be completely coated with an epoxy material and shall be rigid and impervious to total immersion in water and shall also be suited to saline environment. The coil drive shall be Pulsed DC. Leads shall be adequately supported.

| Features                 | Requirements                                                                                     |
|--------------------------|--------------------------------------------------------------------------------------------------|
| ELECTRODE MATERIAL       | SS316L                                                                                           |
| CONSTRUCTION             | COMPACT-TRANSMITTER & SENSOR in flanged connection or wafer connection suitable for pipe flange. |
| TRANSMITTER MOUNTING     | DIRECT ON FLOWTUBE                                                                               |
| CASE                     | DIE CAST ALLUMINIUM                                                                              |
| ENCLOSURE CLASS          | WP TO IP-67 NEMA 4X                                                                              |
| POWER SUPPLY             | 230V AC, 50 Hz                                                                                   |
| TRANSMITTER OUTPUT       | 4-20mA DC, GALVANICALLY ISOLATED with Superimposed HART signal                                   |
| CABLE ENTRY              | 1/2" NPT (F)                                                                                     |
| ACCURACY                 | $\pm 0.5\%$ OF RANGE                                                                             |
| REPEATABILITY            | $\pm 0.5\%$ OF RANGE                                                                             |
| DISPLAY                  | LCD                                                                                              |
| METALLIC GROUNDING RINGS | 2 NOS REQUIRED PER FLOW TRANSMITTER                                                              |

### 3.3.0 LEVEL INSTRUMENTATION

#### Scope of supply:

- Differential Pressure Flow/Level Transmitter, SS316 tubing with 5 valve manifold, SS316 isolation valve, fittings and mounting accessories.

Differential pressure type level transmitter accuracy shall be within 0.075% of calibrated span and shall have repeatability of +0.1% of span or better. Errors caused by change in ambient temperature shall not exceed 0.01% of span per°C change. Temperature variations of +55°C shall not affect the 0.1% accuracy rating nor the 0.1% repeatability.

a. Differential pressure type level transmitters are electronic, analog 2-wire transmitters with 4-20 mA dc output signals. Displacer and ultrasonic level transmitters will be 24V DC powered, with 4-20



mA dc output signals powered from the transmitters. Displacer type level transmitters are of torque tube type.

b. Constant head chambers shall be furnished for all differential pressure-type level transmitters used with pressurised vessels..

c. Transparent gauge glasses will be used for low-pressure applications. Transparent or reflex gauges will be used for high-pressure applications. All gauge glasses will be equipped with gauge valves, including a safety ball check.

d. Level switches shall generally be cage float / Displacer type, rated for ANSI B31.1 requirements.

e. Non contact type level measurement shall be provide for CW sumps and for CW makeup applications.

Hydrostatic level transmitter Accuracy- $\pm 0.1\%$  or better:

All other level transmitter : Accuracy  $\pm 0.25\%$  or better

Level switch : Contact type – snap acting

Contact rating – 230 V AC, 5A, / 24V DC, 1A

Repeatability : -  $\pm 0.5\%$  FSR

### 3.4.0 CONTROL VALVES

a. Control Valves are defined as Pneumatic operated modulating valves.

b. Control valves for regulating service will be pneumatically operated and provided with characterized plugs. In general, equal percentage characteristics will be provided for throttling service; linear characteristics for pressure reducing applications and quick opening characteristics for On/Off service.

c. Control valves will be designed to prevent cavitation, flashing on the downstream side of valve or piping. For cavitation /flashing services, valves with anti-cavitation trims will be provided. Hardened trim material shall be provided for control valves subjected to DP > 7 bar and for flashing applications 17 – 4 PH material is recommended.

d. The control valves will be of straight through globe body double port balanced type or of Angle body except for large cooling water lines.

e. Instrument air shutoff valve shall be provided on each control valve assembly.

f. The following end connections shall be used when weld type connections are specified in the piping line specification :

g. Valve bodies shall be Globe, single – port unless otherwise required and shall be not more than two nominal sizes smaller than the line in which they are installed.

h. Valve body material shall be as specified in the piping line specifications.

i. All integrally mounted instrumentation (controllers, positioners, regulators, etc.) to be designed for a maximum instrument air supply pressure of 7bar

(g). Minimum instrument air supply pressure is 4.5 bar(g). Separate air filter regulators with inlet and outlet gauges shall be provided for each control valve.

j. **SMART positioners with HART compatibility shall be provided for all the control valves.**

k. Color of the control valve shall be identified based on the fail safe position of the valve.

l. All the control valve shall be provided with block and bypass valves. The bypass valves shall be motor operated manual inching valves for critical applications only.

m. It is the intent that the valves shall fail either open or closed or fail lock in the event of failure of air signal or electric signal from any valve component (controller or positioner), as well as failure of the main control air supply or voltage to the solenoid.

n. Position transmitters of non-contact, 2-wire 4-20mA DC type shall be provided for modulating control valves. Also in general limit switches shall be provided for control valves wherever applicable.

o. Pilot solenoid valves for on-off service control valves are to be designed for 24 Vdc with a minimum orifice size of  $\frac{1}{4}$  inch. Limit switches (open and close) to be provided for all on-off valves.

p. Instrument tubing is to be stainless steel, in accordance with the tubing line specifications. Minimum tubing size is  $\frac{1}{4}$  inch, SS-316.

q. Control valve limit switches to be designed to operate at 24 VDC.

|                                                                                  |                                                                        |                            |
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r. The control valves shall generally have the max. flow handling capacity of 120% and the limit of valve travel shall generally be between 10% and 80%. The trim characteristics shall be so selected that the control valve is operated in the controlled flow range of 20 – 75 %.

### 3.4.1 PNEUMATIC ACTUATOR & ACCESSORIES FOR CONTROL VALVE

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Quantity                        | 01 No. for each Pneumatic Operated Valve (POV)                                                                                                                                                                                                                                                                                                                                                                                                   |
| Type                            | Pneumatic Rotary (Rack & Pinion)/diaphragm Double acting/single acting as applicable                                                                                                                                                                                                                                                                                                                                                             |
| Air Connection                  | 1/4" NPT(F) SS316 tube                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Hand wheel for manual operation | Required                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Torque capacity                 | Vendor to select to suit torque requirement of valve type,size & rating.                                                                                                                                                                                                                                                                                                                                                                         |
| Positioner                      | Smart type with HART communication protocol, With regulating input as 2 wire 4-20 mA(24 V). Housed in cast aluminum casing (with polyurethane paint); IP65 degree of protection for enclosure. Material of accessories shall be SS. The allowable drift rate will be +2% of set point/ hour maximum. The positioner shall be mounted on the actuator.                                                                                            |
| Valve position transmitter      | Required with output indicating position of valve as 2 wire 4-20 Ma (24 V).                                                                                                                                                                                                                                                                                                                                                                      |
| Air Filter Regulator            | Quantity: One for each valve.<br>Type: Manual Drain<br>Inlet :5 – 7 Kg / sq. cm<br>Filtering particles: > 5 microns<br>Filter Element: Sintered bronze/Phosphor bronze/Polypropylene<br>Output pressure: 0 – 7 Kg / sq. cm<br>Output Gauge Range : 0-10 Kg/sq.cm<br>Output Pressure Gauge dial: 50 mm Diameter.<br>Blow down valve: To be provided<br>Air connection Inlet :Suitable SS316 end fittings to be provided for 1/4" NPT SS 316 tube. |

### 3.5.0 ANALYSERS

#### 3.5.1 pH MEASUREMENT

Scope of supply:

- pH Sensor, Analyser, Sensor to analyser cable, standard solution / calibration accessories,sample flow through chamber SS316 isolation valve, fittings and mounting accessories.
- a. Solid state / micro processor based system with system accuracy of +/- 0.01 pH, auto span and zero calibration, manual zero and span calibration,.
- b. Output shall be isolated 4-20 mA DC linear signal. Housing for cell and analyzer shall be IP 55 weather and water proof.
- c. The pH shall have built-in reference chambers.
- d. For pH measurement, reference calomel / silver, silver-chloride electrode shall be of rugged and sealed construction moulded in glass coupled polypropylene. Electrical connection shall be made directly on to the outer end of the element ensuring better electrical performance of the electrode. Wherever, variations in sample temperature may occur, automatic temperature compensation device shall be provided.



e. pH analyser shall have local indication and display shall be LCD based display with keypad etc. Calibration with standard buffer solutions preferably two point calibration and with features such as adjustable zero & span. Power Supply shall be 240V, 50Hz, 1ph, AC and terminal block to suit 2.5 sqmm wires. Mounting bracket shall be supplied for 2"Pipe / Rack mounting with associated fasteners.

Sample flow through chamber shall be provided for pH sensor with sample inlet at bottom and sample drain at top side.

### **3.5.2 ORP MEASUREMENT**

Scope of supply:

- ORP Sensor, Analyser, Sensor to analyser cable, standard solution / calibration accessories, sample flow through chamber, SS316 isolation valve, fittings and mounting accessories.

a. Solid state / microprocessor based system with system accuracy of  $\pm 1$  mV, auto span and zero calibration, manual zero and span calibration, integral display indication.

b. Output shall be isolated 4-20 mA DC linear signal. Housing for cell and analyzer shall be IP 55 weather and water proof.

c. The ORP sensor shall have built-in reference chambers.

e. ORP analyser shall have local indication and display shall be LCD based display with keypad etc. Calibration with standard buffer solutions preferably two point calibration and with features such as adjustable zero & span. Power Supply shall be 240V, 50Hz, 1ph, AC and terminal block to suit 2.5 sqmm wires. Mounting bracket shall be supplied for 2"Pipe / Rack mounting with associated fasteners.

Sample flow through chamber shall be provided for ORP sensor with sample inlet at bottom and sample drain at top side.

### **3.5.3 CONDUCTIVITY MEASUREMENT**

Scope of supply:

- Conductivity Sensor, Analyser, Sensor to analyser cable, standard solution / calibration accessories, sample flow through chamber SS316 isolation valve, fittings and mounting accessories.

a. Solid state / micro-processor based system with an accuracy of  $\pm 0.5$  %FSD, auto zero and span calibration, integral indicator having flow line (screwed) type cell. Housing for cell and analyzer shall be IP 55 weather and water proof. Output shall be isolated 4-20 mA DC linear signal.

b. The conductivity sensors shall have built-in reference chambers.

c. The conductivity cell shall in general be of flow through type or insertion type depending upon the area of application.

d. Conductivity transmitter shall have local indication and provision for automatic temperature compensation up to 100 deg. C.

e. Conductivity sensor range (cell constant) shall be selected based on sample conductivity to achieve maximum possible linearity.

f. Display shall be LCD based display with keypad etc. Calibration shall be possible with standard buffer solutions and with features such as adjustable zero & span. Power Supply shall be 240V, 50Hz, 1ph, AC and terminal block to suit 2.5 sqmm wires. Mounting bracket shall be supplied for 2"Pipe / Rack mounting with associated fasteners.

Sample flow through chamber shall be provided for conductivity sensor with sample inlet at bottom and sample drain at top side.

### **3.5.4 TURBIDITY MEASUREMENT**

Scope of supply:

- Turbidity Sensor, Analyser, Sensor cable, standard solution / calibration accessories, Debubbling chamber SS316 isolation valve, fittings and mounting accessories.



a. Solid state / micro-processor based system with an accuracy of  $\pm 0.5\%$  FSD, auto zero and span calibration. Sensor, Analyser, Sensor cable & debubbling chamber shall be IP 55 weather and water proof. Output shall be isolated 4-20 mA DC linear signal.

b. Method of measurement shall be optical deflection principle complying with US EPA method 180.1 or ISO Method 7027. Display resolution shall be 0.1 NTU Minimum. Calibration shall be possible with standard calibration solution. e. Display shall be LCD based display with keypad etc. Calibration shall be possible with standard buffer solutions and with features such as adjustable zero & span. Power Supply shall be 240V, 50Hz, 1ph, AC and terminal block to suit 2.5 sqmm wires. Mounting bracket shall be supplied for 2"Pipe / Rack mounting with associated fasteners.

### **3.5.5 SILICA MEASUREMENT (IF APPLICABLE)**

Scope of supply

- Silica analyser including single channel analyser, mounting panel without reagents set
- Reagent set for Silica analyser

a. Solid State/micro-processor based system for silica measurement in demineralised water having silica in the range of 0.5 to 15 ppb at ambient temperature and pressure between 0.5- 1.0 bar with an accuracy of  $\pm 5\%$  of span or 2ppb whichever is minimum, response time better than 15 min for 90% change, six numbers of sample streams having features like auto zero & span calibration with manual provision also, ambient temperature compensation and integral indicator. Minimum Detection Limit : 0.5 ppb

b. Self diagnostic features shall include alarm for no reagent, calibration fault and silica concentration low/high. Analyzer housing shall be weather and water proof.

c. Power Supply shall be 240V, 50Hz, 1ph, AC and terminal block to suit 2.5 sqmm wires. Output shall be isolated 4-20 mA DC linear signal. Alarms shall be realized by relay contacts.

d. Sample handling unit comprising of solenoid valves, manifolds, etc.

e. Housing for cell and analyzer shall be IP 55 weather and water proof.

f. The supplied analyser shall be Panel mounted type housed in a CRCA enclosure with min IP 32 rating. Base frame shall be ISMC 75 with min. 2 holes for cable entry. Panel wiring drawings shall be provided with clear marking of power and signal terminals segregated within the panel.

- Power cable termination: Terminal block to suit 2.5 sq.mm cable.
- Signal cable termination: Terminal block to suit 2 pair 0.5 sq.mm individual and overall shielded cable.
- Sample Inlet: 12.7mm OD SS316 Tube Double compression ferrule bulk head fitting

### **3.5.6 CHLORINE ANALYZER (IF APPLICABLE)**

Scope of supply:

- Chlorine Sensor, Analyser, Sensor to analyser cable, standard solution / calibration accessories, sample flow through chamber SS316 isolation valve, fittings and mounting accessories.

a. Solid state / microprocessor based system with system accuracy of  $\pm 1\%$  of span, manual zero and span calibration, integral display indication and as applicable automatic temperature compensation.

b. Output shall be isolated 4-20 mA DC linear signal. Housing for cell and analyzer shall be IP 55 weather and water proof.

c. ORP analyser shall have local indication and display shall be LCD based display with keypad etc. Calibration with standard buffer solutions preferably two point calibration and with features such as adjustable zero & span. Power Supply shall be 240V, 50Hz, 1ph, AC and terminal block to suit 2.5 sqmm wires. Mounting bracket shall be supplied for 2"Pipe / Rack mounting with associated fasteners.

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Sample flow through chamber shall be provided for ORP sensor with sample inlet at bottom and sample drain at top side.

### 3.6.0 SOLENOID VALVES

- On line two (2) way solenoid valves shall be provided, where process line of less than 2 inch with low pressure & temperature application is involved.
- Three (3) way solenoid valves shall be provided commonly, where the pressure is admitted or exhausted from a diaphragm valve or single acting cylinder. Four (4) way solenoid valve shall be provided for operating double acting cylinders, if applicable. Dual coil Solenoid valves shall be supplied for equipment trips and single coil for balance.
- Construction shall be with Body material of bronze/SS316, plug material of SS316 shall be provided with a leakage class of class IV, suitable for instrument air pressure in range OF 5 TO 7 bar.
- All single coil solenoids shall be of continuous duty operating on 24V DC and insulation class shall be H. Manual override provision required.
- 5/2 way Solenoid valve suitable for double acting actuator.

### 3.6.1 SOLENOID VALVE ENCLOSURE BOX (IF APPLICABLE)

- Solenoid Valve Enclosure Box shall be supplied with required no. of solenoid valves, Air Filter cum Regulator (AFR), tubing with necessary fittings, floor mounting supports, internal wiring, cable glands & lugs, Terminal Blocks (TBs) etc.
- The solenoid valve coil wires shall be terminated in a terminal block located inside the enclosure box. The solenoid box shall be sized to terminate the valve feedback signal cables with necessary provision in box dimension and extra space in gland plate.
- The inlet ports of the solenoid valves shall be connected to a common inlet manifold to which the air supply will be connected at site through an AFR. The outlet / vent connections of the solenoid valve shall also be connected using SS 316 double compression type bulkhead tube fittings.
- Stickers have to be fixed for the SOV to indicate tag number. Separate Tag plates shall be mounted with plate screws for each outgoing impulse tube .Tag numbers shall be legibly inscribed on the tag plates.
- Protection class shall be IP-65 minimum.30% spare terminals shall be supplied in each Solenoid Valve Enclosure Box.

Inlet line size & common header: ½" OD SS316 Tube Double compression ferrule bulk head fitting

Outlet line size (To POVs) : ¼" OD SS316 Tube Double compression ferrule bulk head fitting

### 3.6.2 PNEUMATIC ACTUATOR & ACCESSORIES FOR ON-OFF VALVE

|                                          |                                                                                                                                                                                                                                                             |
|------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Quantity                                 | 01 No. for each Pneumatic Operated Valve (POV)                                                                                                                                                                                                              |
| Type                                     | Pneumatic Rotary (Rack & Pinion)/Diaphragm type Double acting/Single acting as per process requirement                                                                                                                                                      |
| Pressure                                 | 5-7 Kg /sq. cm                                                                                                                                                                                                                                              |
| Air Connection                           | ¼" NPT(F) SS316 tube                                                                                                                                                                                                                                        |
| Hand wheel for manual operation          | Required                                                                                                                                                                                                                                                    |
| State of driven equipment on air failure | Stay put/Fail open/Fail close as per process requirement                                                                                                                                                                                                    |
| Torque capacity                          | Vendor to select to suit torque requirement of valve type, size & rating.                                                                                                                                                                                   |
| Limit Switch                             | One for Open & one for Close position for each POV with 2 NO+2NC potential free contacts in each limit switch. Contact rating shall be 5A, 240V AC , 0.5A, 220 V DC. Enclosure shall be weather proof IP 55. Limit Switch terminals shall be brought out to |



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a Terminal Block.

### 3.7.0 PROCESS IMPULSE LINES /TUBES & FITTINGS

Impulse lines for instruments shall be ½" OD tubing of SS316 material according to ASTM A-269. All fittings to be used for tubing shall also be SS316, double compression type of standard make. Impulse pipes for high pressure applications shall be used with material and rating as same as that of the process line. Size and thickness of piping/tubing shall be suitable for the design pressure and temperature conditions as per ANSI16.11.

Compression tube fittings are used in low pressure process systems. For impulse pipes/tubes and fittings, Test certificate shall be provided as applicable. Tubing shall be complete with union connections and end fittings at supply and receiving ends. Bulk head fitting socket welded type to be provided at instrument rack/enclosure.

Impulse pipes, fittings and air supply and signal piping/tubing shall be supplied for all the instruments under the scope of this specification. Instrument piping shall be designed for maximum design pressure and temperature of the process.

Instrument air tubing shall be SS. Minimum bending radius of instrument sensing line is 3 times the tube diameter. Instrument sensing lines are sloped in their horizontal runs, a minimum of ½" per foot.

In general, liquid and steam lines slope from their process tap connection down to the instrument. In general, gas and non-condensing vapor lines slope from their process tap connection up to the instrument.

Instrument sensing lines shall be routed as directly as practicable from the process root valve to the instrument. The length of instrument tubing from the root valve to the instrument shall be limited to maximum of 12 meters for compressible fluids and 15 meters for non-compressible fluids. Wherever it is not possible to access the main root valve an additional root valve shall be provided near to the instrument.

Instrument sensing lines shall be grouped together as much as possible to benefit from the use of common support members and to present a finished installation that is routed in a neat and orderly manner..

When instruments are mounted local to the tapping point and are not mounted in the rack, or panel or enclosure, the drains shall be connected to the nearest floor level or plant drain.

### 3.7.1 INSTRUMENT VALVES AND MANIFOLDS

Bidder shall supply instrument valves and valve manifolds as per the Instrument Installation / Mounting diagrams. Globe construction with Body material and rating shall be SS316 whichever is better and shall be forged type. Valve trim material shall be SS316.

### 3.8.0 JUNCTION BOXES

Bidder shall supply junction boxes wherever required. These shall be of Industrial grade Fibre glass Reinforced Polyester (FRP) to weather proof, with cable entering on bottom and side entry shall be provided.

These boxes shall have terminals suitable for min 2.5 mm<sup>2</sup> cable termination (klip on) mounted on rails. 30% spare terminals shall be supplied in each junction box. Junction box shall be provided with double compression glands.

Telephone socket shall be provided in junction boxes. Each junction box shall have a minimum of 20% or 2 nos., whichever is more, spare entry duly provided with plugs (weather proof/explosion proof, as applicable). Protection class shall be IP-65 minimum for JB and enclosures.

### 3.9.0 INSTRUMENT AIR SUPPLY SYSTEM



|                                                                                   |                                                                        |                            |
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Dry instrument air with the Dew Point not less than: -40 deg c ) shall be distributed to various equipment of I&C system like control valves, Analyzer purging, pneumatic On-Off dampers.

#### AIR FILTER CUM REGULATOR

Air filter regulator along with gauges shall be provided in each of the

- Air supply line to valve positioners /power cylinders
  - Air supply line to electric to pneumatic converters
  - Air supply line to pneumatic interlocked block valves
- a) Air filter regulator shall be manual Drain type suitable for inlet pressure in range of 5 – 7 bar. Filter Element shall be sintered bronze/Phosphor Bronze/Polypropylene capable of filtering particle above 5 microns.
  - b) Air filter regulator shall regulate output pressure in range of 0 – 7 bar. Output Pressure Gauge of dial size 50 mm Diameter shall be provided. Blow down valve shall be also be provided.

#### 3.9.1 PIPING SUPPORTS

- a) All field mounted instrument tubing shall be supported with steel angles/channels of a minimum 1/8" thickness fabricated to present a neat appearance. Sharp corners in the support material to be avoided.

#### 3.10.0 INSTRUMENT SIGNAL CABLES

- a) All Instrumentation Cables shall be of 600V grades and Control cables shall be of 1100V FRLS, PVC insulated, armoured 7-stranded copper conductor cable to be provided as per the latest IS/IEC standards.
  - Analog Signal cable :600V, 0.5 Sq.mm for single pair, screened
  - 600V, 0.5 Sq mm for multipair, individual pair and overallshielded.
  - Binary signal Cable :1100V Screened with overall screen
  - 1100V 0.5 Sq mm for 2 Cores
  - 1100V 0.5 Sq mm for multi core
- b) Control Cable : 1.5 mm<sup>2</sup> copper control cable would be used for cabling between MCC and Control system
- c) Power cable : 2.5 Sq.mm for 3 Cores
- d) After commissioning 20% of the conductors of multi core cables shall be available as spare.
- e) All instrument cables shall be laid on cable trays. Cable trays shall be sized to have 20% spare space as a minimum.
- f) Junction boxes shall be segregated depending on the type of signal.
- g) All the shield wires shall be terminated in the JB as per Cable Schedule.
- h) Separate JB shall be used for PLC inputs and outputs. JB shall be earthed through GI flat. Separate JB shall be provided for intrinsic safe circuits. Fiber optic cables shall be routed in GI conduits. All panel wiring shall have sufficient spares for future expandability.
- i) All newly supplied electrical MV/LV/Control panels, Local control panels and Junction boxes, transformers, etc shall be painted with RAL 7032.

#### 3.11.0 VARIABLE FREQUENCY DRIVE PANEL (FOR PUMPS/BLOWERS AS SPECIFIED IN MECHANICAL SPECIFICATION/ AS PER PROCESS REQUIREMENT)

##### 3.11.1 Input power supply

Power supply for each motor : 415 V/400 V, ±10%, 50Hz, ±5%, 3phase, 3 wire effectively earthed with voltage variation of ±10% and frequency variation of ±5% and absolute sum of 10%.

##### 3.11.2 Auxiliary power supply

The control supply required for VFD panel shall be derived with suitable control transformers sized to meet the control circuit load and motor space heater load.



### 3.11.3 Output signals

Output signals to the PLC system shall be

- Speed rate (Frequency): analog signal (4-20 mA)
- Motor ON Feedback
- Motor OFF Feedback
- Motor Trip Feedback
- Bypass DOL ON Feedback

### 3.11.4 Input signals

Drive shall operate based on the following signal from PLC.

1. 24 VDC signal for following
  - Drive Start
  - Drive Stop
2. Speed Reference Analog signal (4 – 20 mA) from PLC system

## 3.12.0 DESIGN REQUIREMENTS(Complying to IEC 61800 -2)

### 3.12.1 PERFORMANCE REQUIREMENTS

- a) The power converter shall operate the motor over a speed range of 20% to 100%.
- b) The operator interface shall be installed on the front panel to control all parameters and the reference information related to the correct VFD function.
- c) VFD shall be able to drive motor without change in normal motor temperature.
- d) VFD shall be able to drive motor with no appreciable increase in motor audible noise.
- e) The drive shall operate with a fundamental Power factor of 0.97 or better.
- f) Voltage at motor neutral terminal shall be maintained at ground potential for the total operating condition.
- g) The drive motor shall be speed controlled corresponding to 4- 20mA reference signal. Unless otherwise specified, upon complete loss of the users speed reference signal, the drive shall automatically run at constant speed as at the last speed reference available prior to the loss of signal.
- h) The speed of the drive shall be varied in either manual or auto mode.
- i) With the selector switch in “Manual” mode, the speed reference shall be set through keypad, mounted on the drive front or from the speed increase/decrease push buttons.
- j) With selector switch in “auto” mode, speed of the motor shall be controlled from a 4-20mA signal from PLC system. Necessary signal converters as required for interfacing with PLC system shall be provided in the drive panel.

### 3.12.2 Panel Construction

- a) The Panel shall be free standing, floor mounted, dust and vermin proof type. The protection degree shall be minimum IP32.
- b) The drive shall be housed in panels with 2mm thick cold rolled sheet steel. The panel enclosure and structure supports shall be thoroughly cleaned and degreased to remove mill scales and rust.
- c) The equipment shall be able to run at the ambient condition without decreasing its power output.
- d) The supplier shall have good references and be in a position to guarantee the supply of spare parts for the whole life span of the plant.
- e) Gland plate minimum 3 mm thickness shall be provided at bottom of the panel. Clamp type terminals shall be used for wires upto 10 sq.mm and bolted type terminals for higher sizes. Minimum space for power cable termination shall be 600 mm clear from bottom of gland plate.
- f) In each VFD panel 20% unconnected spare terminals shall be considered.



- g) Each of the drive shall have their front door mounted display panel consisting of backlit alphanumeric display and a keypad with keys for parameterisation and adjusting parameters such as Start/stop, Local/Remote, Auto/Manual, Increase/Decrease, menu navigation, and measurement parameter selection etc.
- h) The drive panel shall be natural /forced cooled type. For adequate cooling air flow, cooling fan shall be considered.
- i) MCB for motor space heater, auxiliary power supply for the panel shall be included and mounted in easy accessible location.
- j) Earth bus min. 25x6 mm size shall be provided in the panel. Separate earth bus bar and stud for electronic control system as required shall be provided.
- k) All the control wiring shall be done in plastic channel. Each wire shall be identified at both ends by PVC ferrules. Power and control wiring shall be done with BIS approved, PVC insulated, fire retardant, copper conductor wire. For circuits having 10A or less 1.5 sq.mm, 2.5 sq.mm for control circuit of 16A rating. All wires shall be ferruled and terminals shall be properly numbered, minimum 30% spare terminals to be provided. Terminals of Power, control & PLC interface shall be segregated with proper spacing.
- l) For the Start/Stop commands from PLC panel, the interposing relays (24 V DC ) type shall be provided.
- m) For the Speed reference analog signal from PLC panel, the 4-20mA input signal card shall be provided. If a signal input other than 4-20mA analog signal is envisaged, suitable converters shall be provided by the vendor.
- n) Bidder has to supply the Double compressor type Brass Cable Glands and heavy duty Annealed Tinned Copper (ATC) Lugs are to be envisaged in bidder scope.

### 3.12.3 BYPASS FEATURE

- a) A Bypass breaker /contactor-HRC fuse complete with protection and metering shall be provided.
- b) All Variable Frequency Drives (VFD) having by-pass feature shall have motor protection relay along with necessary control and metering etc.
- c) Safety interlock between inverter and by-pass breaker/contactor shall be provided such that the closing of healthy device is inhibited in case of external fault.

### 3.12.4 Indicator Lamps

1. Motor running
2. Motor Stopped
3. Motor Trip
4. Bypass DOL ON
5. Bypass DOL OFF
6. VFD Internal Fault

Above indications may be provided on the door mount of VFD panel. Potential free contacts to be wired for remote indication shall be decided during detail engineering.

### 3.12.5 Control

The following controls can be provided as a part of the VFD panel.

1. Start/stop
2. Speed control (Raise/Lower)
3. Auto/Manual/Test mode
4. VFD drive/ Bypass DOL
5. Emergency Stop



#### **4.0.0 QUALITY ASSURANCE, SHOP INSPECTION AND TESTING**

##### **4.1.0 General**

a. This section contains general requirements for inspection of material, parts, equipment and workmanship of the plant during manufacture, assembling to demonstrate compliance with specification, codes and standards to ensure overall reliability of plant operation and performance.

b. The Owner and/or authorized Representatives shall, at any time, be allowed free and ready access to the Bidder's premises and those of his suppliers as well as to the site installation and the Bidder has to make the plant items available for the purpose of inspecting the specified equipment components and obtaining information as to the progress of the work. Failure on the part of the Owner, at this or any other time, to discover or reject materials or work which do not meet specified requirements shall not be deemed an acceptance thereof nor a waiver of defects therein. The approval of the Owner shall not prejudice the right to reject equipment if it does not give complete satisfaction in service.

##### **4.2.0 Scope**

a. All materials, components and equipments covered under this specification shall be tested at all stages of procurement, manufacturing, erection, commissioning as per a comprehensive quality assurance programme. The requirements of minimum quality plans to be followed by the Bidder in respect of various equipment are specified in detailed technical specification. The Bidder shall draw his own quality plans in line with these requirements and his standard practices and implement such programme after approval by the purchaser.

b. Manufacturing quality plan shall detail out, for all the components and equipments, various tests/inspection to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by bidder's quality control organization, the relevant reference document and standards, acceptance norms and inspection documents raised etc. during all stages of material procurement, manufacture, assembly and final testing/performance testing.

c. The Bidder has primary responsibility for ensuring the quality of items of equipment supplied under the contract and remains accountable when manufacture or erection is subcontracted. It is therefore a requirement of the specification that work is only subcontracted to companies with effective quality control organizations and that the Bidder monitors the performance of these by the attendance at tests of experienced inspectors employed by the Bidder. The Bidder shall, at the appropriate time, prove that his material and / or equipment comply with all the requirements of this Section, such proof being the successful completion of tests and inspections. Routine test and type test certificates shall be submitted for each item of equipment, wherever applicable.

d. All materials, components and equipment supplied under the contract shall be subject to inspection by the Owner, his representative, Inspectors of Boilers or his authorized Agency or any other Inspector, should they so require during manufacture, erection and after completion. The necessary inspection charges of the authorized agency of Inspection of Boilers shall be borne by the bidder. The inspection and tests shall include but shall not be limited to the requirements of this section of the specification. Further requirements to be applied are specified in the detailed specification. The Bidder along with quality plan, shall also furnish copies of the reference documents/plant standards/acceptance norms/test and inspection procedure etc. referred by him in quality plans. These quality plans and reference documents/standards etc. will be subject to purchaser's approval and will form apart of the contract. In these approved quality plans, purchaser shall identify customer hold points (CHP), indicating tests/checks which shall be carried out in presence of the purchaser's engineer or authorized representative and beyond which work will not proceed without consent of purchaser's Engineer/authorized representative in writing.

f. No materials/equipment shall be dispatched from the manufacturer's works before the same is either accepted subsequent to pre-dispatch final inspection including verification of records of all previous tests/inspections by purchaser's Engineer /authorized representatives, or such pre-dispatch final inspection is waived by the purchaser and dispatch is authorized after review of test reports.



g. All materials used or supplied shall be accompanied by valid and approved material certificates and test and inspection reports duly approved by the purchaser. These certificates and reports shall indicate the acceptable identification number of the material they proposed to certify. The material certified shall also have the identification details stamped on it.

h. All material used for equipment construction including castings and forgings etc. shall be of tested quality as per relevant codes/standards. Details of results of the test conducted to determine the mechanical properties, chemical analysis and details of heat treatment procedures recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details.

g. All the sub-vendors proposed by the Bidder for procurement of major bought out items including castings, forgings, pumps, heat exchangers, semi finished and finished components/equipment-(list of which shall be drawn up by the Bidder along with his offer and finalized with the purchaser) shall be subject to purchaser's approval. The type and extent of inspection of items shall be in accordance with the relevant International Standards and other standards approved by the Owner, supplemented or amended by the requirements of this section of the specification or as specified elsewhere in the Specification.

#### **4.3.0 Inspection Program and Test Notifications**

a. Before manufacture commences and not later than 45 days after award of contract, the Bidder shall submit an outline of his proposed inspection program, which shall include all major stages during manufacturing. The inspection and test program shall include for the various items the designation No., name of equipment, part of equipment, the kind of test, test standard, company which carries out the test, place, date and witnesses by the Bidder, third party or Owner's Representative.

b. The Owner will return a copy of the Bidder's proposed inspection program indicating those inspection stages for which notification is required. Notification shall be by Fax or email in a format to be agreed and shall be sent at least 20 days prior to the intended test in accordance with 'Conditions of Contract'. If the Owner intends to be represented at the test he will provide at least 24 hours' notice and if his representative does not attend on the notified date, the test may proceed unless an alternative date has been requested by the Owner.

#### **4.4.0 Test Certificate Documentation**

The results of all tests shall be certified by the manufacturer, Bidder or independent agency as appropriate.

Document files containing material certificates, welding procedures, test report etc. shall be compiled for each item of plant and shall be suitably identified (including equipment classification reference) and bound.

Three copies of each document file containing inspection reports and certificates of site erection testing activities of a particular item of plant or system shall be supplied to the Owner prior to commissioning.

Copies of the performance and acceptance test reports shall be prepared and distributed as specified in Clause 'Performance and acceptance test data and reports' of this Section. All documentation as required by ASME shall also be prepared and submitted.

#### **4.5.0 Certification of Equipment by Owner's Representatives**

The Personal & travelling costs in connection with the Owner's Representative engineers inspection and witnessing of tests of equipment, components and material manufactured in Africa and abroad will be borne by the Owner.

#### **4.6.0 Codes and Standards**

##### **4.6.1 General**

The type and extent of inspection shall generally be in accordance with that specified in the standard used for design and construction of the item of equipment supplemented or amended by



the requirements of this section of the specification. The Bidder should provide the relevant codes and standard to the Owner.

#### **4.6.2 Reference to Codes and Standards**

Reference to special codes and standards, where designated either directly or as "relevant", is intended to provide a measure of performance, safety, in-shop and on-site testing, and methods of construction and/or installation which must be equalled or exceeded in order to be considered acceptable for use under this specification. If more than a single degree of quality or accuracy is permitted within the scope of particular code or standard, the highest quality shall be applicable and the degree of accuracy commensurate with the intended function shall be selected, but with the understanding that the final decision will be made by the Owner. In all instances, the finally accepted applicable code or standard shall be the version last published.

#### **4.6.3 Alternative Standards**

Where no appropriate standard is available, tests shall be conducted in accordance with the manufacturer's standard practice, subject to the approval of the Owner. In such cases the Bidder shall submit to the Owner, complete data and a suggested procedure for the testing to be performed. Commencement of manufacture before receipt of the Owner's approval shall be at the Bidder's risk.

If the proposed procedures are accepted, the Bidder shall provide the Owner with four additional copies in English before any test is performed.

#### **4.6.4 Derating Standards**

The Bidder's attention is drawn to the climatic conditions in the site area. Derating factors shall apply in accordance with the relevant and approved standards if not specified in the contract documents.

#### **4.7.0 Services prior to and During Inspection and Testing**

In accordance with and in addition to specified standards the Bidder shall submit procedures for material testing, manufacture, quality control and performance testing as they apply from the procurement phase of raw materials to the finished product. Manufacture commenced before receipt of the Owner's approval of material specifications and testing procedures shall be at the Bidder's risk.

No inspection shall be valid unless the Bidder and manufacturer are in possession of relevant approved drawings and procedures for the item to be tested. The Bidder on request shall supply the Owner's representative with a copy of drawings and procedures at the time of the test.

All instruments and apparatus required for the inspection or used for the performance of tests shall be subject to the approval of the Owner at his discretion and shall be calibrated to an agreed standard in approved laboratories. The cost of making such calibrations shall be borne by the Bidder in all cases.

If the Bidder wishes to apply for a concession in respect of a departure from an approved procedure or standard, this shall be made in writing with full information substantiating the technical acceptability of the proposed change. The Owner's decision shall be final. Concessions granted shall not absolve the Bidder from any of his responsibilities under the Contract.

#### **4.8.0 Testing During Manufacturing**

All the mechanical, electrical and C&I testing requirement to be conducted at manufacturer's works are specified under respective clauses.

|                                                                                  |                                                                        |                            |
|----------------------------------------------------------------------------------|------------------------------------------------------------------------|----------------------------|
|  | <b>SPECIFICATION FOR ELECTRICAL,<br/>CONTROL &amp; INSTRUMENTATION</b> | <b>SPEC. NO.: ROS 4172</b> |
|                                                                                  |                                                                        | <b>REV. NO: 00</b>         |

#### 5.0.0 DRAWING/DOCUMENT SUBMISSION AFTER ORDER

|                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Drawings & Documents to be submitted for Pneumatic Control Valves                        | <ol style="list-style-type: none"> <li>1. Datasheet and/or catalog with selected model number for Actuator, Positioner, Position Transmitter AFR, GA drawing of the complete valve-actuator-accessories arrangement, Datasheet &amp; O&amp;M manual of actuator, positioner, position transmitter and AFR.</li> <li>2. Documents as per Contract Quality Requirements.</li> <li>3. Original certified copies of all test report for equipment and materials.</li> </ol>                                |
| Drawings & Documents to be submitted for Pneumatic On OFF valves                         | <ol style="list-style-type: none"> <li>1. Datasheet and/or catalog with selected model number for Actuator, Limit switch, GA drawing of the complete valve-actuator-accessories arrangement, Datasheet &amp; O&amp;M manual of actuator with Limit switch details.</li> <li>2. Documents as per Contract Quality Requirements.</li> <li>3. Original certified copies of all test report for equipment and materials.</li> </ol>                                                                        |
| Drawings & Documents to be submitted for VFD PANELS                                      | <ol style="list-style-type: none"> <li>1. Schematic diagram, Technical Datasheets, complete operating and maintenance instructions with instruction for equipment storage, installation, GA, IA drawing, Terminal arrangement drawing with list of components used and terminal strip drawing for each model of VFD with cross-reference.</li> <li>2. Documents as per Contract Quality Requirements.</li> <li>3. Original certified copies of all test report for equipment and materials.</li> </ol> |
| Drawings & Documents to be submitted for instruments                                     | <ol style="list-style-type: none"> <li>1. Datasheet and/or catalog with selected model number with list of accessories supplied, list of calibration solutions.</li> <li>2. Documents as per Contract Quality Requirements.</li> <li>3. Original certified copies of all test report for instruments and materials.</li> </ol>                                                                                                                                                                         |
| Drawings & Documents to be submitted for instrumentation cables                          | <ol style="list-style-type: none"> <li>1. Datasheet and/or catalog with details of core, insulation, inner &amp; outer sheath, cross section drawing etc.</li> <li>2. Documents as per Contract Quality Requirements.</li> <li>3. Original certified copies of all test report for cables and materials.</li> </ol>                                                                                                                                                                                    |
| Drawings & Documents to be submitted for LT Motors                                       | <ol style="list-style-type: none"> <li>1. Datasheet of LT motor,</li> <li>2. Documents as per Contract Quality Requirements.</li> <li>3. Original certified copies of all test report for cables and materials.</li> </ol>                                                                                                                                                                                                                                                                             |
| Drawings & Documents to be submitted for PURCHASER'S PLC/DCS                             | Documents such as Sequential Flow Chart, Control philosophy, Detailed IO list, Alarm list for the system                                                                                                                                                                                                                                                                                                                                                                                               |
| Drawings & Documents to be submitted for Junction Boxes & Solenoid Valve Enclosure Boxes | GA drawings showing Terminal arrangement, Construction features                                                                                                                                                                                                                                                                                                                                                                                                                                        |

|                                                                                   |                                                                        |                            |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------------|----------------------------|
|  | <b>SPECIFICATION FOR ELECTRICAL,<br/>CONTROL &amp; INSTRUMENTATION</b> | <b>SPEC. NO.: ROS 4172</b> |
|                                                                                   |                                                                        | <b>REV. NO: 00</b>         |

### 5.0.1 DRAWING/DOCUMENT SUBMISSION AT OFFER STAGE

The bidder shall submit the following documents along with the offer:

1. Signed confirmation of enquiry specification in total.
2. Electrical Load List indicating KW rating and no. of drives as per list enclosed in ROS 6168 specification.

### 6.0.0 MANDATORY SPARES & COMMISSIONING SPARES

#### 6.1.0 MANDATORY SPARES

As per list enclosed in ROS 6168 specification.

#### 6.2.0 COMMISSIONING SPARES

As per list enclosed in ROS 6168 specification.

### 7.0.0 LIST OF APPROVED SUB-VENDORS

As per list enclosed in ROS 6168 specification.

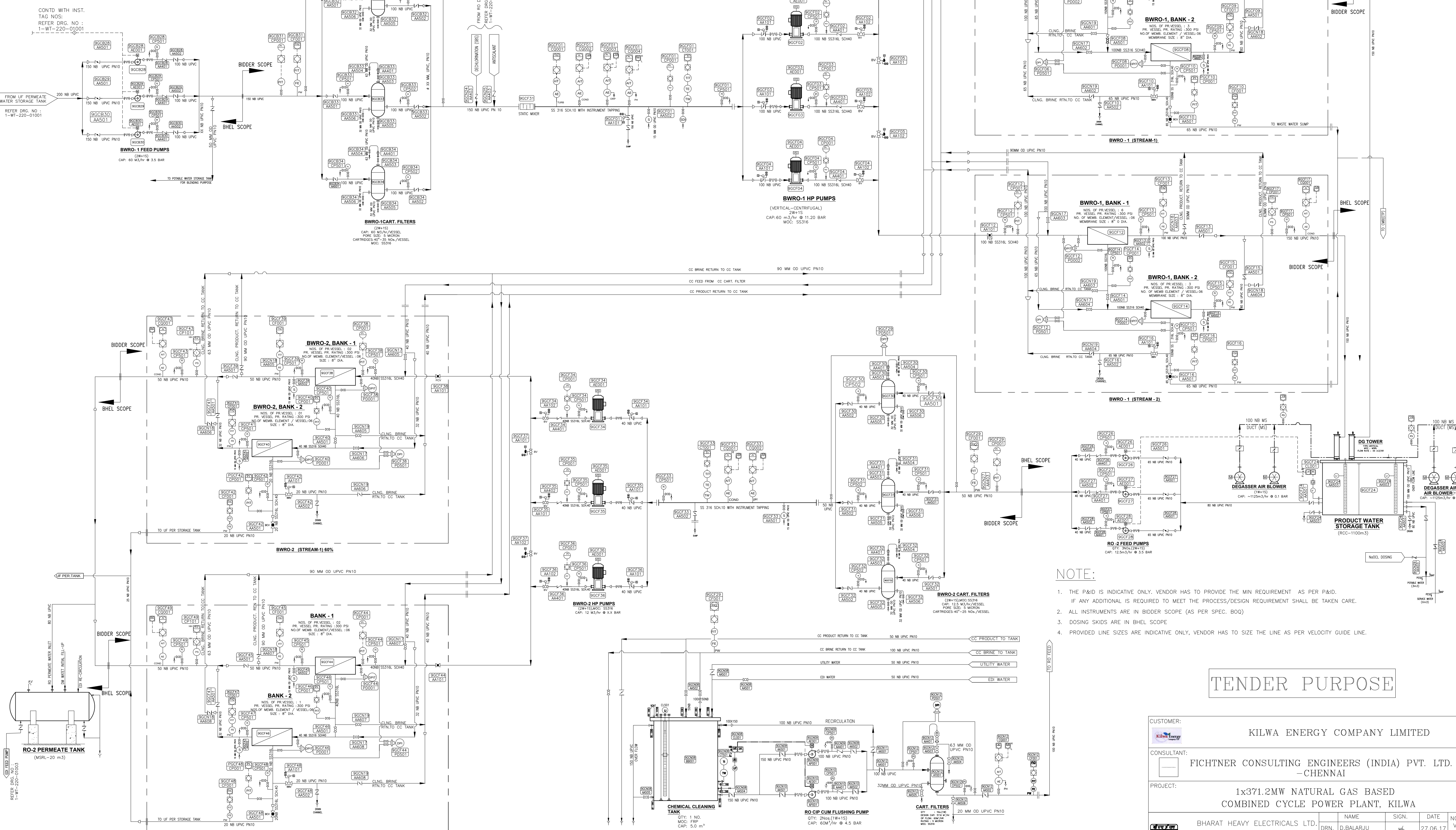
The Bidder shall provide a list of Sub-Vendors along with the Bid. The same shall be reviewed during the detailed engineering subject to end user approval. All the Sub-Vendors must have supplied equipment for a similar duty and application with proven experience. These manufacturers/ suppliers/ sub-vendors should have received ISO 9000 qualification (Certification of approval) from International Standard Organisation, at least three (3) years old and such qualifications are currently valid. The bidder shall provide evidence to confirm this qualification when requested.

### 8.0.0 LIST OF INSTRUMENTS - SCOPE OF SUPPLY

Refer **Annexure –A** of ROS 4172 specification.



GENERAL DIMENSIONAL LIMITS, FITS & TOLERANCES AS PER HY0230261



1. THE P&ID IS INDICATIVE ONLY. VENDOR HAS TO PROVIDE THE MIN REQUIREMENT AS PER P&ID.  
IF ANY ADDITIONAL IS REQUIRED TO MEET THE PROCESS/DESIGN REQUIREMENT SHALL BE TAKEN CARE.
2. ALL INSTRUMENTS ARE IN BIDDER SCOPE (AS PER SPEC. BOQ)
3. DOSING SKIDS ARE IN BHEL SCOPE
4. PROVIDED LINE SIZES ARE INDICATIVE ONLY, VENDOR HAS TO SIZE THE LINE AS PER VELOCITY GUIDE LINE.

## KILWA ENERGY COMPANY LIMITED

|                                                                                       |                                |           |            |               |      |
|---------------------------------------------------------------------------------------|--------------------------------|-----------|------------|---------------|------|
|  | BHARAT HEAVY ELECTRICALS LTD.  |           |            | NO.OF<br>VAR. |      |
|                                                                                       | UNIT: BOILER AUXILIARIES PLANT |           |            |               |      |
|                                                                                       | RANIPET-632406                 |           |            |               |      |
|                                                                                       |                                | NAME      | SIGN.      | DATE          | N.A. |
|                                                                                       | DRN.                           | D.BALARJU | <i>sd.</i> | 27.06.17      |      |
|                                                                                       | CHD.                           | P.PALANI  | <i>sd.</i> | 27.06.17      |      |

|              |                              |                                                                                       |       |                                        |                           |             |              |
|--------------|------------------------------|---------------------------------------------------------------------------------------|-------|----------------------------------------|---------------------------|-------------|--------------|
| DEPT.<br>NP  | UNTOOL. DIMS.                |  | SCALE | WEIGHT (KG)                            | REF. TO ASSY. DRG.        | ITEM NO.    | NO. OF ITEMS |
| CODE<br>9776 | GR.<br>9/M/F                 |                                                                                       | N.T.S | N.A.                                   | N.A.                      | N.A.        | N.A.         |
| TITLE        | P&ID FOR RO SYSTEM<br>(PWTS) |                                                                                       |       | CARD<br>CODE<br>PROJECT DRG. NO.<br>NA | DRG.NO.<br>1-WT-150-01043 |             | REV.<br>00   |
|              |                              |                                                                                       |       | SHT. No                                | 01                        | NO. OF SHT. | 01           |

P&ID FOR RO SYSTEM  
(PWTS)



THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED. IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY

COMPUTER FILE NAME

REF. DRG. NO.

SIGN. AND DATE

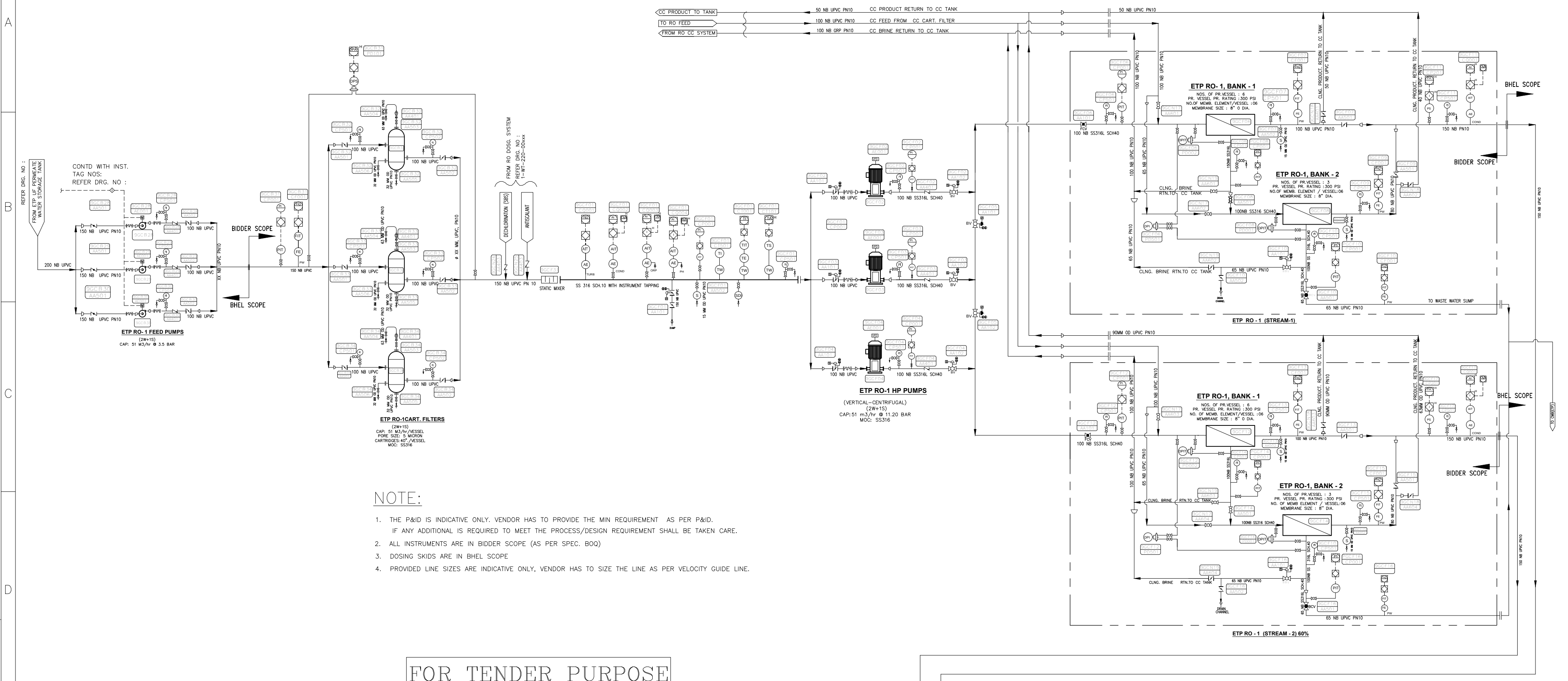
INVENTORY NO

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. 2-WT-220-00248

SHT. 1 OF 1



NOTE:

1. THE P&ID IS INDICATIVE ONLY. VENDOR HAS TO PROVIDE THE MIN REQUIREMENT AS PER P&ID. IF ANY ADDITIONAL IS REQUIRED TO MEET THE PROCESS/DESIGN REQUIREMENT SHALL BE TAKEN CARE.
2. ALL INSTRUMENTS ARE IN BIDDER SCOPE (AS PER SPEC. BOQ)
3. DOSING SKIDS ARE IN BHEL SCOPE
4. PROVIDED LINE SIZES ARE INDICATIVE ONLY. VENDOR HAS TO SIZE THE LINE AS PER VELOCITY GUIDE LINE.

FOR TENDER PURPOSE

CUSTOMER:



KILWA ENERGY COMPANY LIMITED

CONSULTANT:

FICHTNER CONSULTING ENGINEERS (INDIA) PVT. LTD.  
CHENNAI

PROJECT:

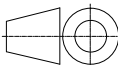
1x371.2MW NATURAL GAS BASED  
COMBINED CYCLE POWER PLANT, KILWA



BHARAT HEAVY ELECTRICALS LTD.

UNIT: BOILER AUXILIARIES PLANT  
RANIPET-632406

|       |          |       |          |            |
|-------|----------|-------|----------|------------|
|       | NAME     | SIGN. | DATE     | NO.OF VAR. |
| DRN.  | BALARAJU | sd.   | 27.06.17 |            |
| CHD.  | P PALANI | sd.   | 27.06.17 | N.A.       |
| APPD. | MN RAJAN | sd.   | 27.06.17 |            |

|                 |                                 |                                                                                       |                |                     |                                                                                                                                                                                                                         |                  |                        |            |  |                  |  |            |                |  |
|-----------------|---------------------------------|---------------------------------------------------------------------------------------|----------------|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|------------------------|------------|--|------------------|--|------------|----------------|--|
| DEPT.<br>PE&SD  | UNTOL. DIMS.<br>GR.<br>9/M/Y    |  | SCALE<br>N.T.S | WEIGHT (KG)<br>N.A. | REF. TO ASSY. DRG.<br>N.A.                                                                                                                                                                                              | ITEM NO.<br>N.A. | NO.OF ITEMS<br>N.A.    |            |  |                  |  |            |                |  |
| CODE<br>9776    | TITLE<br>P&ID FOR ETP RO SYSTEM |                                                                                       |                |                     | <table><tr><td>CARD CODE<br/>NA</td><td>DRG.NO. 1-WT-060-01044</td><td>REV.<br/>00</td></tr><tr><td></td><td>PROJECT DRG. NO.</td><td></td></tr><tr><td>SHT. No 01</td><td colspan="2">NO. OF SHT. 01</td></tr></table> | CARD CODE<br>NA  | DRG.NO. 1-WT-060-01044 | REV.<br>00 |  | PROJECT DRG. NO. |  | SHT. No 01 | NO. OF SHT. 01 |  |
| CARD CODE<br>NA | DRG.NO. 1-WT-060-01044          | REV.<br>00                                                                            |                |                     |                                                                                                                                                                                                                         |                  |                        |            |  |                  |  |            |                |  |
|                 | PROJECT DRG. NO.                |                                                                                       |                |                     |                                                                                                                                                                                                                         |                  |                        |            |  |                  |  |            |                |  |
| SHT. No 01      | NO. OF SHT. 01                  |                                                                                       |                |                     |                                                                                                                                                                                                                         |                  |                        |            |  |                  |  |            |                |  |

BILL OF QUANTITY FOR INSTRUMENTS IN BIDDER SCOPE.

PROJECT: KILWA TANZANIA  
PACKAGE: RO SYSTEM (PWTS)  
Ref. RWT0516/R.00 Dtd. 27.06.17

Dtd. 27.06.17

|                                         |                                                                                             |      |   |     |
|-----------------------------------------|---------------------------------------------------------------------------------------------|------|---|-----|
| <b>BWRO-1CART. FILTERS</b>              |                                                                                             |      |   |     |
| 1                                       | Differential Pressure Indicating Transmitter at Cart.Filters Common line                    | DPIT | 1 | No  |
| 2                                       | Pressure Indicator with isolation Ball Valve                                                | PI   | 3 |     |
| 3                                       | Pressure indicator At Cartridge Filters Outlet line                                         | PI   | 3 |     |
| <b>BWRO-1CART. FILTER OUTLET HEADER</b> |                                                                                             |      |   |     |
| 1                                       | Turbidity Analyser At Cartridge filter common outlet line                                   | TURB | 1 | No  |
| 1                                       | Cond Analyser with isolation Ball Valve At Cartridge filter common outlet line              | COND | 1 | No  |
| 2                                       | DRP Analyser with isolation Ball Valve At Cartridge filter common outlet line               | ORP  | 1 | No  |
| 3                                       | PH Analyser With isolation Ball Valve At Cartridge filter common outlet line                | PH   | 1 | No  |
| 4                                       | Temperature Indicating Transmitter At Cartridge filter common Outlet Line                   | TIT  | 1 | No  |
| 5                                       | Pressure Indicator With Isolation Ball Valve At Cartridge filter common Outlet Line         | PI   | 1 | No  |
| <b>BWRO-1 HP Pumps</b>                  |                                                                                             |      |   |     |
| 1                                       | Pressure indicating Transmitter with isolation Ball Valve At Pump Suction line              | PIT  | 3 | Nos |
| 2                                       | Pressure Indicator with isolation Ball Valve At Pump Discharge line                         | PI   | 3 | Nos |
| 3                                       | Pressure indicating Transmitter with isolation Ball Valve At Pump Discharge line            | PIT  | 3 | Nos |
| <b>BWRO-1 STREAM -1</b>                 |                                                                                             |      |   |     |
| 1                                       | Flow Control Valve At Bank 1 Inlet Line                                                     | FCV  | 1 | No  |
| 2                                       | Pressure Indicator With isolation Ball Valve At Bank 1 Inlet Line                           | PI   | 1 | No  |
| 3                                       | Pressure Indicating Transmitter With isolation Ball Valve At Bank 1 Inlet Line              | PIT  | 1 | No  |
| 4                                       | Differential Pressure Indicator With isolation Ball Valve At Bank 1&2 Inlet Line            | DPI  | 1 | No  |
| 5                                       | Differential Pressure Indicating Transmitter With isolation ball Valve At Bank 1 Inlet Line | DPIT | 1 | No  |
| 6                                       | Pressure Indicator With isolation Ball valve At Bank 1 Outlet Line                          | PI   | 2 | Nos |
| 7                                       | Pressure Indicating Transmitter With isolation Ball Valve At Bank 1 Outlet line             | PIT  | 1 | No  |
| 8                                       | Flow Indicating Transmitter At Bank 1Outlet Line                                            | FIT  | 1 | No  |
| 9                                       | Differential Pressure Indicating Transmitter With isolation ball Valve At Bank 2 Inlet Line | DPIT | 1 | No  |
| 10                                      | Pressure Indicator with isolation Ball Valve At Bank 2 Outlet Line                          | PI   | 1 | No  |
| 11                                      | Pressure Indicating Transmitter With isolation Ball Valve At Bank 2 Outlet Line             | PIT  | 1 | No  |
| 12                                      | Flow Indicating Transmitter At Bank 2 Outlet Line                                           | FIT  | 1 | No  |
| 13                                      | Pressure Indicator with isolation Ball Valve At Bank 2 Outlet Line                          | PI   | 1 | No  |
| 14                                      | Flow Indicating Transmitter At Bank 2Outlet Line                                            | FIT  | 1 | No  |
| 15                                      | Pressure Switch With isolation Ball Valve At Bank1&2 Common Line                            | PS   | 1 | No  |
| 16                                      | Pressure Indicator With Isolation Ball Valve At Bank1&2 Common Line                         | PI   | 1 | No  |
| 17                                      | Conductivity Analyser At Bank1&2 Common Line                                                | AIT  | 1 | No  |
| <b>BWRO-1 STREAM -2</b>                 |                                                                                             |      |   |     |
| 1                                       | Flow Control Valve At Bank 1 Inlet Line                                                     | FCV  | 1 | No  |
| 2                                       | Pressure Indicator With isolation Ball Valve At Bank 1 Inlet Line                           | PI   | 1 | No  |
| 3                                       | Pressure Indicating Transmitter With isolation Ball Valve At Bank 1 Inlet Line              | PIT  | 1 | No  |
| 4                                       | Differential Pressure Indicator With isolation Ball Valve At Bank 1&2 Inlet Line            | DPI  | 1 | No  |
| 5                                       | Differential Pressure Indicating Transmitter With isolation ball Valve At Bank 1 Inlet Line | DPIT | 1 | No  |
| 6                                       | Pressure Indicator With isolation Ball valve At Bank 1 Outlet Line                          | PI   | 2 | Nos |
| 7                                       | Pressure Indicating Transmitter With isolation Ball Valve At Bank 1 Outlet line             | PIT  | 1 | No  |
| 8                                       | Flow Indicating Transmitter At Bank 1Outlet Line                                            | FIT  | 1 | No  |
| 9                                       | Differential Pressure Indicating Transmitter With isolation ball Valve At Bank 2 Inlet Line | DPIT | 1 | No  |
| 10                                      | Pressure Indicator with isolation Ball Valve At Bank 2 Outlet Line                          | PI   | 1 | No  |
| 11                                      | Pressure Indicating Transmitter With isolation Ball Valve At Bank 2 Outlet Line             | PIT  | 1 | No  |
| 12                                      | Flow Indicating Transmitter At Bank 2 Outlet Line                                           | FIT  | 1 | No  |
| 13                                      | Pressure Indicator with isolation Ball Valve At Bank 2 Outlet Line                          | PI   | 1 | No  |
| 14                                      | Flow Indicating Transmitter At Bank 2Outlet Line                                            | FIT  | 1 | No  |
| 15                                      | Pressure Switch With isolation Ball Valve At Bank1&2 Common Line                            | PS   | 1 | No  |
| 16                                      | Pressure Indicator With Isolation Ball Valve At Bank1&2 Common Line                         | PI   | 1 | No  |
| 17                                      | Conductivity Analyser At Bank1&2 Common Line                                                | AIT  | 1 | No  |
| <b>DEGASSER AIR BLOWER 1</b>            |                                                                                             |      |   |     |
| 1                                       | Pressure Switch With isolation Ball Valve At Blower 1                                       | PS   | 2 | No  |
| <b>PRODUCT WATER STORAGE TANK</b>       |                                                                                             |      |   |     |
| 1                                       | Level Indicator At Tank                                                                     | LI   | 2 | Nos |
| 2                                       | Level Indicating Transmitter At Tank Outlet                                                 | LIT  | 1 | No  |
| <b>RO-2 FEED PUMPS</b>                  |                                                                                             |      |   |     |
| 1                                       | Pressure Indicator with isolation Ball Valve At Pump Discharge line                         | PI   | 3 | Nos |
| 2                                       | Pressure indicating Transmitter with isolation Ball Valve At Common pump Discharge line     | PIT  | 1 | No  |
| 3                                       | Flow Indicating transmitter at Common pump Discharge line                                   | FIT  | 1 | No  |
| <b>BWRO-2 CART. FILTERS</b>             |                                                                                             |      |   |     |
| 1                                       | Differential Pressure Switch at Cart.Filters Common line                                    | DPS  | 1 | No  |
| 2                                       | Differential Pressure indicator at Cart.Filters Common line                                 | DPI  | 1 | No  |
| 3                                       | Pressure Indicator with isolation Ball Valve                                                | PI   | 3 | Nos |
| 4                                       | Pressure indicator At Cartridge Filters Outlet line                                         | PI   | 3 | Nos |
| 5                                       | PH Analyser At Cartridge filter common outlet line                                          | PH   | 1 | No  |
| 6                                       | Temperature Indicating Transmitter At Cartridge filter common Outlet Line                   | TIT  | 1 | No  |
| 7                                       | Pressure Indicator With Isolation Ball Valve At Cartridge filter common Outlet Line         | PI   | 1 | No  |

|                                 |                                                                                            |      |   |     |
|---------------------------------|--------------------------------------------------------------------------------------------|------|---|-----|
| <b>BWRO-2 HP Pumps</b>          |                                                                                            |      |   |     |
| 1                               | Pressure indicating Transmitter with isolation Ball Valve At Pump Suction line             | PIT  | 3 | Nos |
| 2                               | Pressure Indicator with isolation Ball Valve At Pump Discharge line                        | PI   | 3 | Nos |
| 3                               | Pressure indicating Transmitter with isolation Ball Valve At Pump Discharge line           | PIT  | 3 | Nos |
| <b>BWRO-2 STREAM -1</b>         |                                                                                            |      |   |     |
| 1                               | Pressure Indicator With isolation Ball Valve At Bank 1 Inlet Line                          | PI   | 1 | No  |
| 2                               | Pressure Indicating Transmitter With isolation Ball Valve At Bank 1 Inlet Line             | PIT  | 1 | No  |
| 3                               | Diffrential Pressure Indicator With isolation Ball Valve At Bank 1&2 Inlet Line            | DPI  | 1 | No  |
| 4                               | Diffrential Pressure Indicating Transmitter With isolation ball Valve At Bank 1 Inlet Line | DPIT | 1 | No  |
| 5                               | Pressure Indicator With isolation Ball valve At Bank 1 Outlet Line                         | PI   | 2 | Nos |
| 6                               | Pressure Indicating Transmitter With isolation Ball Valve At Bank 1 Outlet line            | PIT  | 1 | No  |
| 7                               | Flow Indicating Transmitter At Bank 1Outlet Line                                           | FIT  | 1 | No  |
| 8                               | Diffrential Pressure Indicating Transmitter With isolation ball Valve At Bank 2 Inlet Line | DPIT | 1 | No  |
| 9                               | Pressure Indicator with isolation Ball Valve At Bank 2 Outlet Line                         | PI   | 1 | No  |
| 10                              | Pressure Indicating Transmitter With isolation Ball Valve At Bank 2 Outlet Line            | PIT  | 1 | No  |
| 11                              | Flow Indicating Transmitter At Bank 2Outlet Line                                           | FIT  | 1 | No  |
| 12                              | Pressure Indicator with isolation Ball Valve At Bank 2 Outlet Line                         | PI   | 1 | No  |
| 13                              | Flow Indicating Transmitter At Bank 2Outlet Line                                           | FIT  | 1 | No  |
| 14                              | Pressure Switch With isolation Ball Valve At Bank1&2 Commen Line                           | PS   | 1 | No  |
| 15                              | Pressure Indicator With Isolation Ball Valve At Bank1&2 Commen Line                        | PI   | 1 | No  |
| 16                              | Conductivity Analyser At Bank1&2 Commen Line                                               | AIT  | 1 | No  |
| <b>BWRO-1 STREAM -2</b>         |                                                                                            |      |   |     |
| 1                               | Pressure Indicator With isolation Ball Valve At Bank 1 Inlet Line                          | PI   | 1 | No  |
| 2                               | Pressure Indicating Transmitter With isolation Ball Valve At Bank 1 Inlet Line             | PIT  | 1 | No  |
| 3                               | Diffrential Pressure Indicator With isolation Ball Valve At Bank 1&2 Inlet Line            | DPI  | 1 | No  |
| 4                               | Diffrential Pressure Indicating Transmitter With isolation ball Valve At Bank 1 Inlet Line | DPIT | 1 | No  |
| 5                               | Pressure Indicator With isolation Ball valve At Bank 1 Outlet Line                         | PI   | 2 | Nos |
| 6                               | Pressure Indicating Transmitter With isolation Ball Valve At Bank 1 Outlet line            | PIT  | 1 | No  |
| 7                               | Flow Indicating Transmitter At Bank 1Outlet Line                                           | FIT  | 1 | No  |
| 8                               | Diffrential Pressure Indicating Transmitter With isolation ball Valve At Bank 2 Inlet Line | DPIT | 1 | No  |
| 9                               | Pressure Indicator with isolation Ball Valve At Bank 2 Outlet Line                         | PI   | 1 | No  |
| 10                              | Pressure Indicating Transmitter With isolation Ball Valve At Bank 2 Outlet Line            | PIT  | 1 | No  |
| 11                              | Flow Indicating Transmitter At Bank 2 Outlet Line                                          | FIT  | 1 | No  |
| 12                              | Pressure Indicator with isolation Ball Valve At Bank 2 Outlet Line                         | PI   | 1 | No  |
| 13                              | Flow Indicating Transmitter At Bank 2Outlet Line                                           | FIT  | 1 | No  |
| 14                              | Pressure Switch With isolation Ball Valve At Bank1&2 Commen Line                           | PS   | 1 | No  |
| 15                              | Pressure Indicator With Isolation Ball Valve At Bank1&2 Commen Line                        | PI   | 1 | No  |
| 16                              | Conductivity Analyser At Bank1&2 Commen Line                                               | AIT  | 1 | No  |
| <b>Ro-2 PERMEATE TANK</b>       |                                                                                            |      |   |     |
| 1                               | RO-2 Permeate Tank Level Indicating Transmitter                                            | LIT  | 1 | No  |
| <b>CHEMICAL CLEANING TANK</b>   |                                                                                            |      |   |     |
| 1                               | Level Indicator At tank                                                                    | LI   | 1 | No  |
| 2                               | Temperature Indicator At tank Outlet Line                                                  | TI   | 1 | No  |
| 3                               | Level Indicating Transmitter At Tank Outlet                                                | LIT  | 1 | No  |
| <b>RO CIP CUM FLUSHING PUMP</b> |                                                                                            |      |   |     |
| 1                               | Pressure Indicator with isolation Ball Valve At Pump 1&2 Discharge line                    | PI   | 2 | Nos |
| <b>CART.FILTERS</b>             |                                                                                            |      |   |     |
| 1                               | Diffrential Pressure Indicator with isolation Ball valve At Cartridge Filter Inlet Line    | DPI  | 1 | No  |
| 2                               | Pressure Indicator with Isolation Ball Valve at Cartridge Filter Inlet Line                | PI   | 1 | No  |
| 3                               | Pressure Indicator with Isolation Ball Valve at Cartridge Filter Inlet Line                | PI   | 1 | No  |
| 4                               | PH Analyser With isolation Ball Valve At Cartridge filter outlet line                      | PH   | 1 | No  |
| 5                               | Flow Indicating Transmitter At Cartridge filter outlet line                                | FIT  | 1 | No  |

BILL OF QUANTITY FOR INSTRUMENTS IN BIDDER SCOPE.

PROJECT: KILWA TANZANIA  
PACKAGE: RO SYSTEM (ETP)  
Ref. RWT70516/R.00

Dtd. 27.06.17

|                                         |                                                                                             |      |   |     |  |
|-----------------------------------------|---------------------------------------------------------------------------------------------|------|---|-----|--|
| <b>BWRO-1CART. FILTERS</b>              |                                                                                             |      |   |     |  |
| 1                                       | Differential Pressure Indicating Transmitter at Cart.Filters Common line                    | DPIT | 1 | No  |  |
| 2                                       | Pressure Indicator with isolation Ball Valve                                                | PI   | 3 |     |  |
| 3                                       | Pressure indicator At Cartridge Filters Outlet line                                         | PI   | 3 |     |  |
| <b>BWRO-1CART. FILTER OUTLET HEADER</b> |                                                                                             |      |   |     |  |
| 1                                       | Turbidity Analyser At Cartridge filter commen outlet line                                   | TURB | 1 | No  |  |
| 1                                       | Cond Analyser with isolation Ball Valve At Cartridge filter commen outlet line              | COND | 1 | No  |  |
| 2                                       | DRP Analyser with isolation Ball Valve At Cartridge filter commen outlet line               | ORP  | 1 | No  |  |
| 3                                       | PH Analyser With isolation Ball Valve At Cartridge filter commen outlet line                | PH   | 1 | No  |  |
| 4                                       | Temperature Indicating Transmitter At Cartridge filter commen Outlet Line                   | TIT  | 1 | No  |  |
| 5                                       | Pressure Indicator With Isolation Ball Valve At Cartridge filter commen Outlet Line         | PI   | 1 | No  |  |
| <b>BWRO-1 HP Pumps</b>                  |                                                                                             |      |   |     |  |
| 1                                       | Pressure indicating Transmitter with isolation Ball Valve At Pump Suction line              | PIT  | 3 | Nos |  |
| 2                                       | Pressure Indicator with isolation Ball Valve At Pump Discharge line                         | PI   | 3 | Nos |  |
| 3                                       | Pressure indicating Transmitter with isolation Ball Valve At Pump Discharge line            | PIT  | 3 | Nos |  |
| <b>BWRO-1 STREAM -1</b>                 |                                                                                             |      |   |     |  |
| 1                                       | Flow Control Valve At Bank 1 Inlet Line                                                     | FCV  | 1 | No  |  |
| 2                                       | Pressure Indicator With isolation Ball Valve At Bank 1 Inlet Line                           | PI   | 1 | No  |  |
| 3                                       | Pressure Indicating Transmitter With isolation Ball Valve At Bank 1 Inlet Line              | PIT  | 1 | No  |  |
| 4                                       | Differential Pressure Indicator With isolation Ball Valve At Bank 1&2 Inlet Line            | DPI  | 1 | No  |  |
| 5                                       | Differential Pressure Indicating Transmitter With isolation ball Valve At Bank 1 Inlet Line | DPIT | 1 | No  |  |
| 6                                       | Pressure Indicator With isolation Ball valve At Bank 1 Outlet Line                          | PI   | 2 | Nos |  |
| 7                                       | Pressure Indicating Transmitter With isolation Ball Valve At Bank 1 Outlet line             | PIT  | 1 | No  |  |
| 8                                       | Flow Indicating Transmitter At Bank 1Outlet Line                                            | FIT  | 1 | No  |  |
| 9                                       | Differential Pressure Indicating Transmitter With isolation ball Valve At Bank 2 Inlet Line | DPIT | 1 | No  |  |
| 10                                      | Pressure Indicator with isolation Ball Valve At Bank 2 Outlet Line                          | PI   | 1 | No  |  |
| 11                                      | Pressure Indicating Transmitter With isolation Ball Valve At Bank 2 Outlet Line             | PIT  | 1 | No  |  |
| 12                                      | Flow Indicating Transmitter At Bank 2 Outlet Line                                           | FIT  | 1 | No  |  |
| 13                                      | Pressure Indicator with isolation Ball Valve At Bank 2 Outlet Line                          | PI   | 1 | No  |  |
| 14                                      | Flow Indicating Transmitter At Bank 2Outlet Line                                            | FIT  | 1 | No  |  |
| 15                                      | Pressure Switch With isolation Ball Valve At Bank1&2 Commen Line                            | PS   | 1 | No  |  |
| 16                                      | Pressure Indicator With Isolation Ball Valve At Bank1&2 Commen Line                         | PI   | 1 | No  |  |
| 17                                      | Conductivity Analyser At Bank1&2 Commen Line                                                | AIT  | 1 | No  |  |
| <b>BWRO-1 STREAM -2</b>                 |                                                                                             |      |   |     |  |
| 1                                       | Flow Control Valve At Bank 1 Inlet Line                                                     | FCV  | 1 | No  |  |
| 2                                       | Pressure Indicator With isolation Ball Valve At Bank 1 Inlet Line                           | PI   | 1 | No  |  |
| 3                                       | Pressure Indicating Transmitter With isolation Ball Valve At Bank 1 Inlet Line              | PIT  | 1 | No  |  |
| 4                                       | Differential Pressure Indicator With isolation Ball Valve At Bank 1&2 Inlet Line            | DPI  | 1 | No  |  |
| 5                                       | Differential Pressure Indicating Transmitter With isolation ball Valve At Bank 1 Inlet Line | DPIT | 1 | No  |  |
| 6                                       | Pressure Indicator With isolation Ball valve At Bank 1 Outlet Line                          | PI   | 2 | Nos |  |
| 7                                       | Pressure Indicating Transmitter With isolation Ball Valve At Bank 1 Outlet line             | PIT  | 1 | No  |  |
| 8                                       | Flow Indicating Transmitter At Bank 1Outlet Line                                            | FIT  | 1 | No  |  |
| 9                                       | Differential Pressure Indicating Transmitter With isolation ball Valve At Bank 2 Inlet Line | DPIT | 1 | No  |  |
| 10                                      | Pressure Indicator with isolation Ball Valve At Bank 2 Outlet Line                          | PI   | 1 | No  |  |
| 11                                      | Pressure Indicating Transmitter With isolation Ball Valve At Bank 2 Outlet Line             | PIT  | 1 | No  |  |
| 12                                      | Flow Indicating Transmitter At Bank 2 Outlet Line                                           | FIT  | 1 | No  |  |
| 13                                      | Pressure Indicator with isolation Ball Valve At Bank 2 Outlet Line                          | PI   | 1 | No  |  |
| 14                                      | Flow Indicating Transmitter At Bank 2Outlet Line                                            | FIT  | 1 | No  |  |
| 15                                      | Pressure Switch With isolation Ball Valve At Bank1&2 Commen Line                            | PS   | 1 | No  |  |
| 16                                      | Pressure Indicator With Isolation Ball Valve At Bank1&2 Commen Line                         | PI   | 1 | No  |  |
| 17                                      | Conductivity Analyser At Bank1&2 Commen Line                                                | AIT  | 1 | No  |  |
| <b>PRODUCT WATER STORAGE TANK</b>       |                                                                                             |      |   |     |  |
| 1                                       | Level Indicator At Tank                                                                     | LI   | 2 | Nos |  |
| 2                                       | Level Indicating Transmitter At Tank Outlet                                                 | LIT  | 1 | No  |  |

| ANNEXURE-I                   |                      |                                                |
|------------------------------|----------------------|------------------------------------------------|
| VENDORS LIST                 |                      |                                                |
| Cust. No.: R4P6              |                      |                                                |
| PROJECT : KILWA (1x371.2 MW) |                      | Dtd. 27.06.17                                  |
| Ref. RWT70516 Dtd. 27.06.17  |                      | MECHANICAL                                     |
| SL. No                       | Description of Items | Vendors Proposed                               |
| 1                            | RO MEMBRANES         | GE INDIA INDUSTRIAL PRIVATE LIMITED, BANGALORE |
|                              |                      | DOW CHEMICAL INTERNATIONAL PVT LTD             |
|                              |                      | HYDRANAUTICS -A NITTO DENKO COMPANY            |
|                              |                      | TORAY ASIA PVT LTD                             |
|                              |                      | MITSUI & CO PLANT SYSTEM LTD.                  |
| 2                            | HP CENTRIFUGAL PUMPS | KIRLOSKAR, CHENNAI                             |
|                              |                      | FLOWSERVE, COIMBATORE                          |
|                              |                      | SULZER PUMPS INDIA LTD., CHENNAI               |
|                              |                      | MATHER & PLATT, CHENNAI                        |
|                              |                      | KSB PUMPS LTD., CHENNAI                        |
|                              |                      | ITT CORPORATION INDIA PVT. LTD, MUMBAI         |
|                              |                      | CLYDE UNION LTD , GLASGOW                      |
|                              |                      | GRUNDFOS PUMPS INDIA LTD., CHENNAI             |
|                              |                      | BEST AND CROMPTON ENGG LIMITED., CHENNAI       |
| 3                            | LP CENTRIFUGAL PUMPS | KIRLOSKAR, CHENNAI                             |
|                              |                      | FLOWSERVE, COIMBATORE                          |
|                              |                      | SULZER PUMPS INDIA LTD., CHENNAI               |
|                              |                      | MATHER & PLATT, CHENNAI                        |
|                              |                      | BEST AND CROMPTON ENGG LIMITED., CHENNAI       |
|                              |                      | WIPL LTD, CHENNAI                              |
|                              |                      | KSB PUMPS LTD., CHENNAI                        |
|                              |                      | GRUNDFOS PUMPS INDIA LTD., CHENNAI             |

| ANNEXURE-I                   |                       |                                         |
|------------------------------|-----------------------|-----------------------------------------|
| VENDORS LIST                 |                       |                                         |
| Cust. No.: R4P6              |                       |                                         |
| PROJECT : KILWA (1x371.2 MW) |                       | Dtd. 27.06.17                           |
| Ref. RWT70516 Dtd. 27.06.17  |                       | MECHANICAL                              |
|                              |                       | FLOWMORE LIMITED., GURGAON              |
| 4                            | CARTRIDGE FILTER      | PALL, MUMBAI                            |
|                              |                       | MILLIPORE, BANGALORE                    |
|                              |                       | PTI, TECHNOLOGIES, USA                  |
|                              |                       | ULTRAPURE SCIENTIFICS, MUMBAI           |
|                              |                       | GE INDIA INDUSTRIAL PVT. LTD, BANGALORE |
|                              |                       | PARKSAN FILTERS PVT LTD , MUMBAI        |
|                              |                       | PENTAIR WATER INDIA PVT LTD, CHENNAI    |
| 5                            | GLOBE VALVES          | FOURESS, BANGALORE                      |
|                              |                       | KSB, CHENNAI                            |
|                              |                       | WEIR BDK, CHENNAI                       |
|                              |                       | JCF FLUID FLOW INDIA                    |
|                              |                       | SEVERN GLOCON INDIA PVT.LTD.            |
|                              |                       | KOSO INDIA , NASHIK                     |
|                              |                       | KRISHNA ELECTRICAL INDUSTRIES LTD       |
|                              |                       | SIGMA INDUSTRIES                        |
|                              |                       | JOSHIJAMPALA ENGINEERING PVT LTD        |
|                              |                       | DEMBLA VALVES LTD                       |
|                              |                       | MASCOT VALVES PVT LTD                   |
| 6                            | CAGE TYPE GLOBE VALVE | SEVERN GLOCON INDIA PVT LTD             |
|                              |                       | SIGMA INDUSTRIES                        |
| 7                            | BALL VALVES           | WEIR BDK, CHENNAI                       |
|                              |                       | MICROFINISH VALVES , HUBLI              |
|                              |                       | VIRGO ENGINEERS LIMITD                  |

| <b>ANNEXURE-I</b>                   |                    |                                        |
|-------------------------------------|--------------------|----------------------------------------|
| <b>VENDORS LIST</b>                 |                    |                                        |
| <b>Cust. No.: R4P6</b>              |                    |                                        |
| <b>PROJECT : KILWA (1x371.2 MW)</b> |                    | <b>Dtd. 27.06.17</b>                   |
| <b>Ref. RWT70516 Dtd. 27.06.17</b>  |                    | <b>MECHANICAL</b>                      |
|                                     |                    | BRAY CONTROL INDIA Pvt. LTD, VADODARA  |
|                                     |                    | JCF FLUID FLOW INDIA                   |
|                                     |                    | DELVAL FLOW CONTROLS                   |
|                                     |                    | INTER VALVE (POONAWALLA)               |
|                                     |                    | SIGMA INDUSTRIES, BOMBAY               |
| 8                                   | BUTTERFLY VALVES   | KIRLOSKAR                              |
|                                     |                    | L&T, CHENNAI                           |
|                                     |                    | WEIR BDK, CHENNAI                      |
|                                     |                    | CRANE PROCESS - ALFA LAVAL(Saunders) * |
|                                     |                    | INTER VALVE (POONAWALLA)               |
|                                     |                    | MICROFINISH VALVES , HUBLI             |
|                                     |                    | SIGMA INDUSTRIES, BOMBAY               |
|                                     |                    | BRAY VALVES LTD                        |
|                                     |                    | JCF FLUID FLOW INDIA                   |
| 9                                   | SILENT CHECK VALVE | WEIR BDK, CHENNAI                      |
|                                     |                    | MICROFINISH VALVES , HUBLI             |
|                                     |                    | FLO LINE CORPORATION                   |
|                                     |                    | SIGMA INDUSTRIES, BOMBAY               |
|                                     |                    | JOSHIJAMPALA ENGINEERING PVT LTD       |
|                                     |                    | MULLER STEAM SPECIALITY                |
|                                     |                    | APCO WILLAMTTE                         |
|                                     |                    | PACIFIC VALVE CO LTD                   |
| 10                                  | DIAPHRAGM VALVES   | PROCON ENGINEERS LTD                   |
|                                     | (FOR MB SYSTEM)    | WEIR BDK, CHENNAI                      |
|                                     |                    | SIGMA INDUSTRIES, BOMBAY               |



| ANNEXURE-I                   |                                       |                                                                 |
|------------------------------|---------------------------------------|-----------------------------------------------------------------|
| VENDORS LIST                 |                                       |                                                                 |
| Cust. No.: R4P6              |                                       |                                                                 |
| PROJECT : KILWA (1x371.2 MW) |                                       | Dtd. 27.06.17                                                   |
| Ref. RWT70516 Dtd. 27.06.17  |                                       | MECHANICAL                                                      |
| RICAL & C&I                  |                                       |                                                                 |
| SL. NO                       | DESCRIPTION OF ITEMS                  | VENDORS PROPOSED                                                |
| 11                           | VARIABLE FREQUENCY DRIVE SYSTEM (VFD) | ABB,CHENNAI                                                     |
|                              |                                       | SIEMENS,CHENNAI                                                 |
|                              |                                       | SCHNEIDER,NASIK                                                 |
|                              |                                       | ROCK WELL AUTOMATION,CHENNAI                                    |
|                              |                                       | BHARAT HEAVY ELECTRICALS LIMITED Electronics division,BANGALORE |
|                              |                                       | SUN INDUSTRIAL AUTOMATION & SOLUTIONS,CHENNAI                   |
|                              |                                       | EURO PROCESS AUOMATIK,CHENNAI                                   |
|                              |                                       | TREND ELECTRIC CO. PVT. LTD.,,CHENNAI                           |
|                              |                                       |                                                                 |
| 12                           | LT MOTORS                             | BHARAT BIJILEE LTD,MUMBAI                                       |
|                              |                                       | CROMPTON GREAVES LTD,CHENNAI                                    |
|                              |                                       | SIEMENS LTD,JOKA                                                |
|                              |                                       | ABB,CHENNAI                                                     |
|                              |                                       | KIRLOSKAR ELECTRIC CO. LTD,BENGALORE                            |
|                              |                                       | NGEF (HUBLI) LTD,BENGALORE                                      |
|                              |                                       | LAXMI HYDRAULICS PVT LTD,SOLAPUR                                |
|                              |                                       | JYOTI LIMITED,VADODARA                                          |
|                              |                                       | BHEL ELECTRICAL MACHINES LTD.,KASARAGOD                         |
| 13                           | CONDUCTIVITY ,PH,ORP MEASUREMENT      | <b>INSTRUMENTS</b>                                              |
|                              |                                       | HONEYWELL                                                       |
|                              |                                       | HACH                                                            |
|                              |                                       | YOKOGAWA                                                        |
|                              |                                       | ABB                                                             |

| ANNEXURE-I                   |                         |                                           |
|------------------------------|-------------------------|-------------------------------------------|
| VENDORS LIST                 |                         |                                           |
| Cust. No.: R4P6              |                         |                                           |
| PROJECT : KILWA (1x371.2 MW) |                         | Dtd. 27.06.17                             |
| Ref. RWT70516 Dtd. 27.06.17  |                         | MECHANICAL                                |
|                              |                         | E & H                                     |
|                              |                         | EMERSON PROCESS MANAGEMENT(INDIA) PVT LTD |
|                              |                         | FORBES MARSHALL PVT. LTD.,                |
|                              |                         | POLYMETRON                                |
| 14                           | DIFFERENTIAL PRESSURE   | SWITZER INSTRUMENTS LTD.                  |
|                              | SWITCHES                | VARMA TRAFAG                              |
|                              |                         | BAUMER TECHNOLOGIES INDIA PVT LTD.,       |
|                              |                         | INDFOSS (INDIA) LTD                       |
|                              |                         | AN INSTRUMENTS                            |
|                              |                         | BELLS CONTROLS LTD                        |
|                              |                         | WAAREE INSTRUMENTS LIMITED                |
|                              |                         | GIC                                       |
|                              |                         | GAUGES BOURDON PVT. LTD                   |
| 15                           | PRESSURE / TEMP./ LEVEL | HONEYWELL                                 |
|                              | DIFFERENTIAL PRESSURE   | YOKOGAWA                                  |
|                              | TRANSMITTER             | EMERSON PROCESS MANAGEMENT(INDIA) PVT LTD |
|                              |                         | ABB                                       |
|                              |                         | E & H                                     |
|                              |                         | SIEMENS INDIA LTD                         |
| 16                           | RECEIVER RECORDER /     | YOKOGAWA                                  |
|                              | MULTIPOINT RECORDER/    | HONEYWELL                                 |
|                              | PAPERLESS RECORDER      | ABB                                       |
|                              |                         | EMERSON                                   |
| 17                           | SOLENOID VALVES         | ASCO                                      |
|                              |                         | AVCON                                     |
| 5 of 7                       |                         |                                           |

| <b>ANNEXURE-I</b>                   |                                    |                                             |
|-------------------------------------|------------------------------------|---------------------------------------------|
| <b>VENDORS LIST</b>                 |                                    |                                             |
| <b>Cust. No.: R4P6</b>              |                                    |                                             |
| <b>PROJECT : KILWA (1x371.2 MW)</b> |                                    | <b>Dtd. 27.06.17</b>                        |
| <b>Ref. RWT70516 Dtd. 27.06.17</b>  |                                    | <b>MECHANICAL</b>                           |
|                                     |                                    | ROTEX                                       |
|                                     |                                    | NUCON                                       |
|                                     |                                    | INSTUMENTATION + CONTROL SYSTEM,CHENNAI     |
| 18                                  | FLOW INDICATING                    | ABB                                         |
|                                     | TRANSMITTER                        | YOKOGAWA                                    |
|                                     | (MAGNETIC TYPE)                    | HONEYWELL                                   |
|                                     |                                    | ENDRESS + HAUSER                            |
|                                     |                                    | EMERSON PROCESS MANAGEMENT(INDIA) PVT LTD   |
| 19                                  | FLOW INDICATORS(PADDLE WHEEL TYPE) | GEORGE FISHER,SWITZERLAND                   |
|                                     |                                    | BURKERT USA                                 |
| 20                                  | TURBIDITY ANALYSER                 | HACH                                        |
|                                     |                                    | ENDRESS + HAUSER                            |
|                                     |                                    | FORBES MARSHALL                             |
|                                     |                                    | EMERSON PROCESS MANAGEMENT PVT. LTD.        |
| 21                                  | SILICA MEASUREMENT                 | HACH                                        |
|                                     |                                    | EMERSON                                     |
|                                     |                                    | FORBES MARSHALL, PUNE                       |
|                                     |                                    | STEAM EQUIPMENT, PUNE                       |
|                                     |                                    | FLOW LINE INSTRUMENT, BANGALORE             |
|                                     |                                    | ENDRESS & HAUSER, PUNE                      |
| 22                                  | PNEUMATIC ACTUATOR                 | ELOMATIC INDIA LTD                          |
|                                     | (ON / OFF)                         | VIRGO ENGINEERS LTD                         |
|                                     |                                    | FISCHER XOMOX LTD                           |
|                                     |                                    | CRANE PROCESS FLOW TECHNOLOGIES (REVO MAKE) |

| <b>ANNEXURE-I</b>                   |                                                              |                                                             |
|-------------------------------------|--------------------------------------------------------------|-------------------------------------------------------------|
| <b>VENDORS LIST</b>                 |                                                              |                                                             |
| <b>Cust. No.: R4P6</b>              |                                                              |                                                             |
| <b>PROJECT : KILWA (1x371.2 MW)</b> |                                                              | <b>Dtd. 27.06.17</b>                                        |
| <b>Ref. RWT70516 Dtd. 27.06.17</b>  |                                                              | <b>MECHANICAL</b>                                           |
|                                     |                                                              | WEIR BDK                                                    |
|                                     |                                                              | MIL, KOCHIN KERALA                                          |
|                                     |                                                              | ROTEX LTD                                                   |
|                                     |                                                              | INSTRUMENTATION LIMITED, Palakkad                           |
|                                     |                                                              | KERALA STATE ELECTRONICS DEVELOPMENT CORPORATION LTD, Aroor |
| 23                                  | SOLENOID VLAVE<br>ENCLOSURE BOX                              | ASCO NUMATICS (INDIA) PRIVATE LIMITED                       |
|                                     |                                                              | AVCON CONTROLS (P) LTD                                      |
|                                     |                                                              | NUCON PNEUMATICS PVT LTD                                    |
|                                     |                                                              | ROTEX AUTOMATION LIMITED                                    |
|                                     |                                                              |                                                             |
|                                     | Note : Vendor has to supply each equipment/item be one make. |                                                             |
|                                     |                                                              |                                                             |
|                                     |                                                              |                                                             |

**VOLUME IIB**

**TECHNICAL SPECIFICATION  
FOR  
SEAWORTHY PACKING FOR EXPORT JOBS**

**SPECIFICATION NO. PE-TS-888-100-A001**



**BHARAT HEAVY ELECTRICALS LIMITED  
POWER SECTOR  
PROJECT ENGINEERING MANAGEMENT  
NEW DELHI, INDIA**

|                                                                                   |                                                                                                  |                                             |                 |
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## 1.0 Purpose

The purpose of this specification is to describe minimum packing requirements for the different items/equipment for all export Project and also to define marking and shipping requirements during transportation by ship, road and air for all export jobs.

## 2.0 SCOPE

For export jobs, sea worthy packing capable of performing all necessary functions like prevention of damage to the contents, sufficient to support frequent handling and lengthy period of outdoor storage in adverse weather conditions are required. Workmanship and materials used shall be of high standard meeting the technical requirements and in accordance with best commercial export packing practices. Vendor shall be responsible for sea worthy export packing, however it shall meet the minimum requirements specified herein. Equivalent or better packing methods may be deployed subject to approval of the BHEL/Purchaser. Vendor shall submit the packing procedure for its equivalent for purchaser's approval during detailed engineering.

The scope this specification is to define VENDOR's responsibilities in terms of:

- Preservation of the GOODS/items/equipments before packing.
- Packing of the GOODS for road, rail, sea and/or air transportation to desired destination i.e. project site
- Making cases/crates
- Chemical Treatment/Fumigation before packing to prevent fungus, damage due to termite, borer, rats, etc.
- Marking of cases/crates.
- Other Services required.

## 3.0 Application

This specification is applicable to all the goods to be transported to project site and requires to be in transit for longer duration. *However, for "Misc cable erection items", "Fire sealing system" & "Exothermic welding material", the packing requirements shall be as per the procurement specification.*

## 4.0 Definitions

- "BHEL" : Main EPC vendor
- "OWNER" : Customer for a particular export project.
- "VENDOR" : Company(ies)/VENDOR(s) to whom the BHEL has placed Purchase Order for GOODS/ items/system/package.
- "GOODS": means all or part of the articles, material, equipment supplies including technical documentation, as described in the Purchase Order, to be supplied by VENDOR.
- "PACKER": Packaging Company to whom VENDOR intends to sub-contract the packing in case they do not have own packing capability/facilities .
- "FREIGHT FORWARDER" : Means the Company responsible for performing freight forwarding activities.

## 5. General Information

|                                                                                   |                                                                                                  |                                             |                 |
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The following requirements are intended as minimum requirements, and compliance to these requirements in no way absolves or relieves **VENDOR** of any responsibility or obligation outlined in the Purchase Order. In all circumstances, the packing will be designed and constructed in order to support **GOODS** during transportation as well as to prevent the Goods from damage due to impact, extreme climatic conditions, sun and rain. It must be ensured that the delivery of the **GOODS** to the jobsite by sea, road or air, in good condition.

**GOODS** shall be export packed in compliance with the best-established practices for international projects, in accordance with the following instructions. In the event of any conflict between these specified requirement and the established practices, specification requirement shall govern.

Due to climatic conditions and the complex transport operation(s), it is essential that protection and packing is of the highest standard. Packing means to efficiently protect the **GOODS** during the total transport operation; from the moment they leave the factory until they are delivered to the jobsite, including handling operations (loading/unloading) and storage.

When **VENDOR** do not have packing capabilities/facilities of their own and therefore intends to sub-contract, **VENDOR** have to inform **BHEL/Purchaser** of the name and address of proposed **PACKER(s)** for approval.

#### **6.0 Criteria for Selection of Packaging**

Packages are to be made according to categories, described in articles 8.1 to 8.5, depending on the type of materials, their fragility and size.

These categories have been established for the protection of equipment and material during multi-mode transports, i.e.: combination of overland and sea transport; containerization, air transportation.

In a general manner, the **GOODS** have to be packed in such a way that crates, bundles, pallets can be stored into General Purpose containers, wherever possible.

If **VENDOR** has any doubt about the correct method of protection or packing, he should contact **BHEL/Purchaser** in order to mutually agree on the adequate type of packing to be used.

Materials can be classified in following categories

- Hazardous Material
- Non-Hazardous Material
- 

Further to above categorisation, non-hazardous materials can be sub- categorised for selection of packing.

#### **6.1 Hazardous Materials**

Though handling of hazardous material may is not applicable in the scope of this specification. All hazardous material must be packed in adherence to the detailed requirement relating to packing, marking and labelling set out in the most recent report of the Board's Standard Advisory Committee on the Carriage of Dangerous Goods in Ships for sea freight, and the Restricted Articles Regulations, laid down by the International Air Transport Association for airfreight.

#### **6.2 Non-Hazardous GOODS**

The scope of this specification is to provide necessary guidelines for packing for power plant equipment, components, Pipings & Valves, Fittings, other structural items, electrical items, spare parts and erection materials. The procedure is defined in subsequent paragraphs in details in clause no. 8.0.

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## **7.0 Marking Instructions & Despatch details, Storage Code**

### **7.1 Marking Instructions & despatch details**

Packages and crates will be marked with indelible black paint, resistant to seawater. Marking must be perfectly legible.

The shipping marks, which will be as per fig-13, shall be stencilled on two sides and one end in clear characters at least 5 centimetres high (where crate size permits, otherwise use optimum size for each package dimension).

When the GOODS are to be shipped in containers then marking may be stencilled on one end only. However, packages must be stowed in a manner that shows these marks.

Crates containing fragile articles must be packed with special precaution against risk of breakage and must be stencilled on all sides "FRAGILE - HANDLE WITH CARE". Where crates are not to be overturned, VENDOR must show on the crates, clear and readily visible identification as per fig-12, to ensure they are kept in the correct position.

Packages/equipment of 2,000 kg or more must be marked with slinging points on all sides, in addition to the centre of gravity marks.

Number packages consecutively i.e. 1 of 10, 2 of 10, etc. Do not duplicate package numbers. VENDOR is responsible for any loss or damage caused by incorrect marking.

All cases/crates shall also be marked with the appropriate international standard graphic symbols for handling as shown in Fig 12.

As a minimum, all cases/crates are to be marked clearly on all four sides with:

- "HANDLE WITH CARE"
- "RIGHT SIDE UP"
- "KEEP DRY"

In the case of packages with a single gross weight totalling 2,000 kg and/or a height of more than 1m, the centre of gravity shall be clearly marked with the symbol on two adjoining sides. For all items of equipment with an eccentric centre of gravity this symbol shall be marked at the bottom, side and top of the package.

The slinging and lashing points shall be marked with a chain symbol.

When packing in cases/crates, these packages shall also have metal corners at the slinging points. (Fig-11)

External front and rear sides of the boxes to be planed for writing instructions.

Dispatch details such as consigner/consignee address, contract and case details, country of origin, port of delivery, stacking instructions shall be written on one side of the boxes. An anodized aluminum plate as per details and specifications given in fig-13 shall be provided on one side of the boxes.

One copy of packing slip wrapped in polyethylene bag covered with aluminum packing slip holder to be nailed on the external surface of the box. One more copy of the packing slip wrapped in polyethylene bag is to be kept inside the box at the pertinent place.



|                                                                                   |                                                                                                  |                                             |                 |
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## 7.2 Storage Code

The type of storage required is required to be specified, it will be shown on each packaging in **RED colour**.

- X Crates or packages to be stored outdoor without covers
- XX Crates or packages to be stored under tarpaulin
- XXX Crates or packages to be stored in covered or enclosed premises
- XXXX Crates or packages which must be stored in air-conditioned premises

## 8.0 GUIDELINES FOR PACKING GOODS

**8.1** In the subsequent paragraphs details of different types of packings for different types of GOODS are defined. Vendor shall make packing details/procedure based on the guidelines and submit for approval.

### 8.1.1 Packing for Pipe, Fittings, Flanges and Valves, Structural Steel

Particular attention should be brought to pipe, fittings, flanges, valves and structural steel. Packing categories for piping and fittings will differ according to the diameter and wall thickness of these products. VENDOR shall comply with the following established practice.

#### IMPORTANT NOTE:

*Depending on the project schedule and availability of ocean vessels, the piping and structural steel may be shipped in containers. In this event, VENDOR has to arrange the packages in such a way it allows the stuffing into Open Top in gauge containers.*

### 8.1.2 Pipe

Where practicable, pipe lengths shall be limited to 11.8 meters.

All pipes 2" included and below shall be packed in crates. All pipes to be capped and ends sealed with waterproof tape.

Pipes over 2" up to 6", shall be bundled and banded in bundles of uniform length. Bundling is carried out with U-IRON or traversal planks, joined with threaded connecting rods with locknuts. Quantities and strapping positions depend on the lengths, with a 120 cm spacing to prevent distortion. Bundle weight shall not exceed 2,000 kg. All pipes are to be capped and ends sealed with waterproof tape (tape is not necessary if end caps are of the pre-shrunk or self-sealing type).

Pipes larger than 6" shall be shipped as single lengths with the ends capped. End caps are to be of the recessed type to enable the use of soft faced hooks, but still completely sealing the end and also protecting the weld.

All stainless steel piping must be packed separately in wooden crates. Any banding of bundles is to be with the same material.

### 8.1.3 Pipe Fittings, Flanges and Valves

All pipe fittings, flanges and valves up to 6", are to be packed in cases/crates. For items over 6", these may be fixed securely to a pallet base and enclosed in a crate, for protection. Where valves have actuators attached, rigidity must be ensured for the valve and actuator. The vulnerable parts of the actuator are to be completely protected within a wooden crate.

All stainless steel fittings, flanges and valves of all sizes, must be packed separately in wooden crates. Any strapping is to be with the same material.

### 8.1.4 Structural Steel

|                                                                                   |                                                                                                  |                                      |                 |
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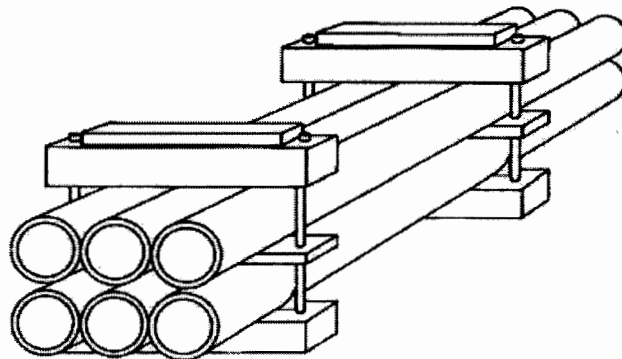
Structural Steel, reinforcing rods, bars, etc., should be packed in bundles of uniform length. Refer to articles 8.1.2, for strapping requirements. Bundle weight not normally to exceed 2,000 kg. Fabricated structures and structural steelwork, etc, should be bundled and packed using wooden beams and long bolting to secure the load.

## 8.2 Bundling – Packing Category I

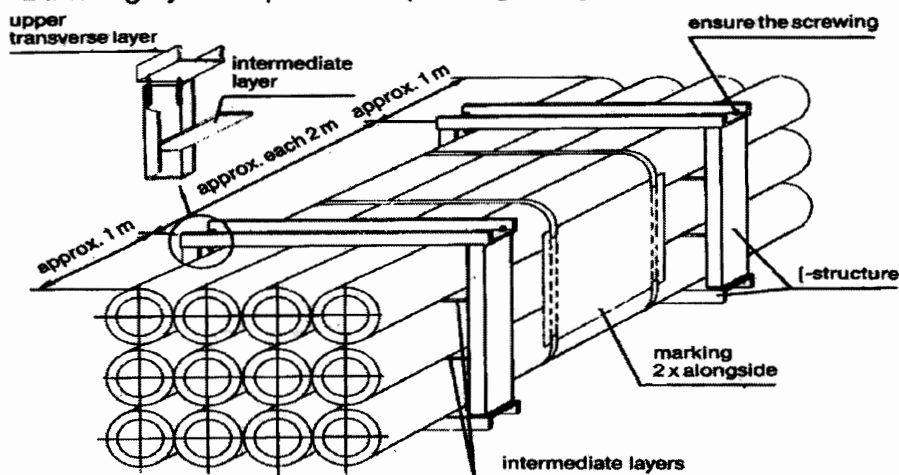
### 8.2.1 Type of Equipment

Equipment which is not subject to damage by corrosion or mechanical effect, i.e. pipes, piping, structural steel.

#### Packing category I



#### Bundling by U-shaped iron – packing category I A



### 8.2.2 Type of Construction

|                                                                                   |                                                                                                  |                                      |                 |
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- Bundling has to be effected
- By squared timber and threaded rods.
- With an intermediate layer (threaded on tightening bolts) according to the weight of the package.
- Wedge-shaped timbers must be added at the outer points of lower layer.
- Between the bolts a spacer must be nailed.
- The bolts must be secured (e.g. by locking nut).
- If single parts could protrude, an appropriate protection must be installed (flat iron or plates).
- Bundling with steel straps or PVC straps is not accepted.

### 8.3 Skids, Square Timber Constructions, Casings – Packing (Category II)

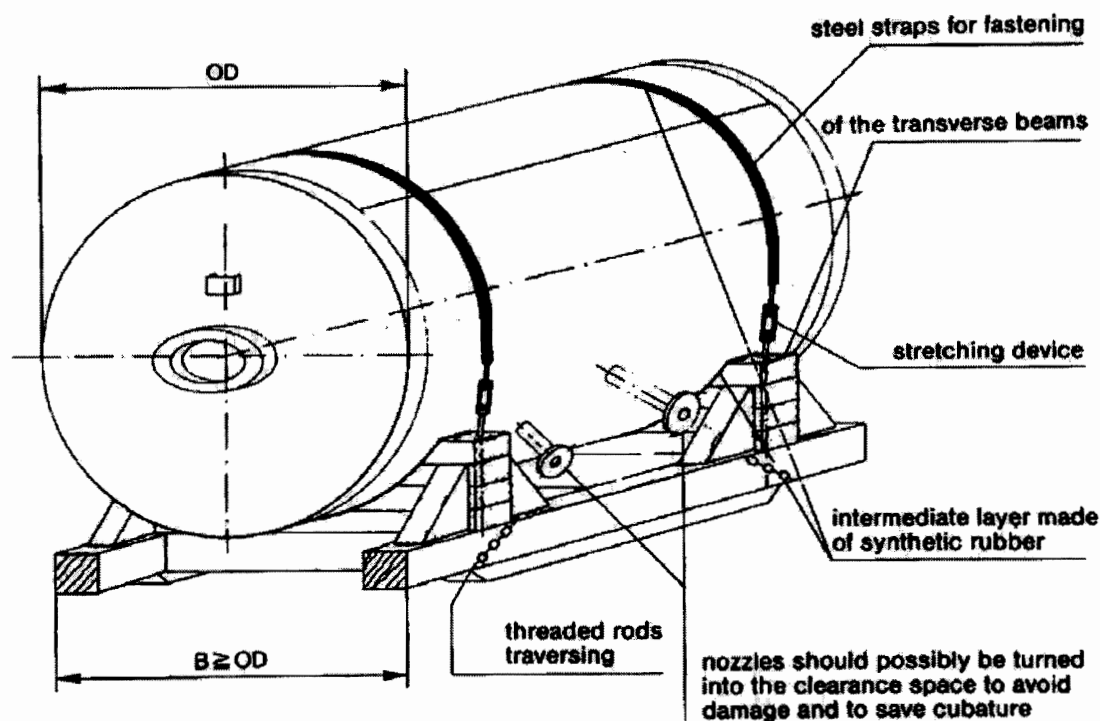
#### 8.3.1 Type of Equipment

Voluminous apparatus, tanks and/or heavy pieces those are not vulnerable to mechanical or corrosive effects.

#### 8.3.2 Type of Construction

- The construction skid can be made of wood or of metal.
- The fastening of the packages on the skid will be made by steel straps (flat iron) which have to be elastically lined, non-slip and securely bolted onto the skids.
- Flange openings have to be closed with gaskets and blind flanges or, if necessary, provided with cover.
- Skid constructions may not be less than the dimensions of the package in length or in width.
- Tanks and apparatus with their own support cradles must be supplied with an anti-slip lining.

#### PACKING CATEGORY-II



|                                                                                   |                                                                                                  |                                      |                 |
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#### 8.4 Packing of GOODS in Wooden Crates/Cases/Boxes

*The construction of wooden crate/cases/boxes shall be as per the details indicated in clause 9.0 & Fig 1 to 11. Details indicated in the sketches for different categories Packing crates/boxes are only for a typical equipment considered for illustration.*

##### 8.4.1 Packing Category III

###### 8.4.1.1 Type of Equipment

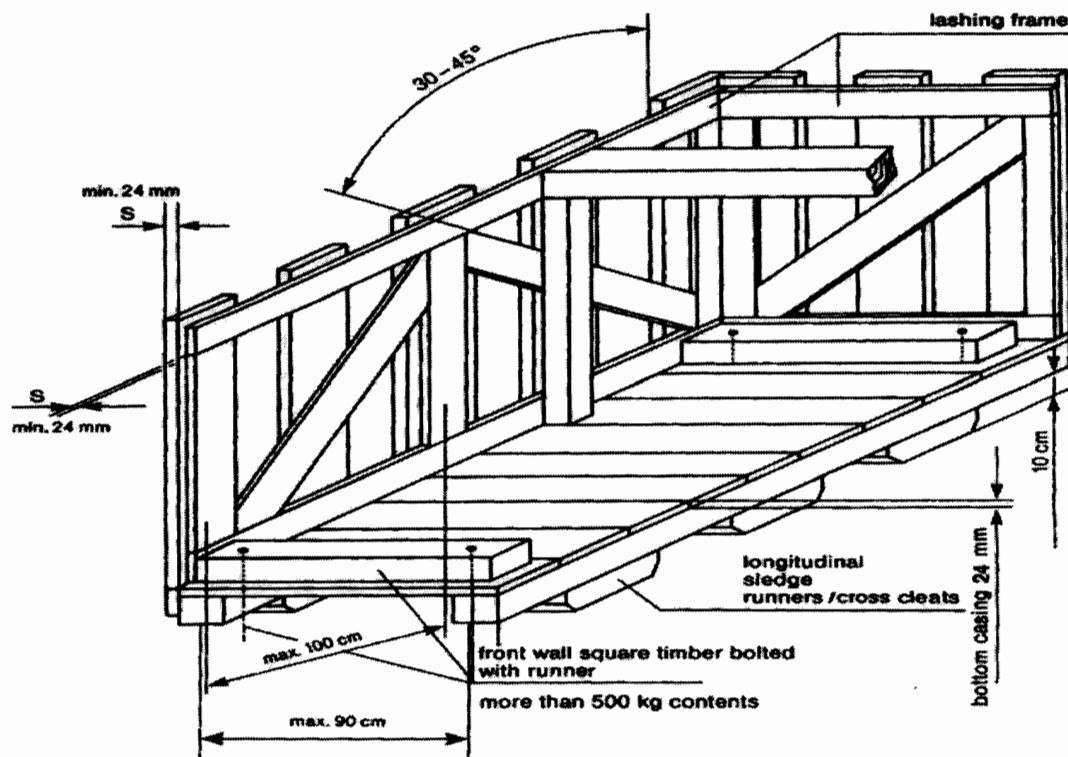
Fabricated equipment, which cannot be transported on cradles; frame-works, prefabricated piping and fittings, mechanical and electrical assemblies. *This type of packing is recommended where many parts of the equipment/component/assembly are not protruding out.*

###### 8.4.1.2 Type of Construction

The equipment must be safely fastened to the bottom with bolts, possibly by the runners or to be spread in such a manner that no protruding parts are possible. For parts, sensitive to rainwater and/or debris, a protection has to be made by a foil cap.

If it is possible that single part could protrude through the front/back side wall, they shall be closed completely. The marking of the package shall be done on plywood plates at the prescribed sides.

##### Packing Category III



|  |                                                                                                  |                                      |                 |
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## 8.4.2 Cases with Lining – Packing Category IV

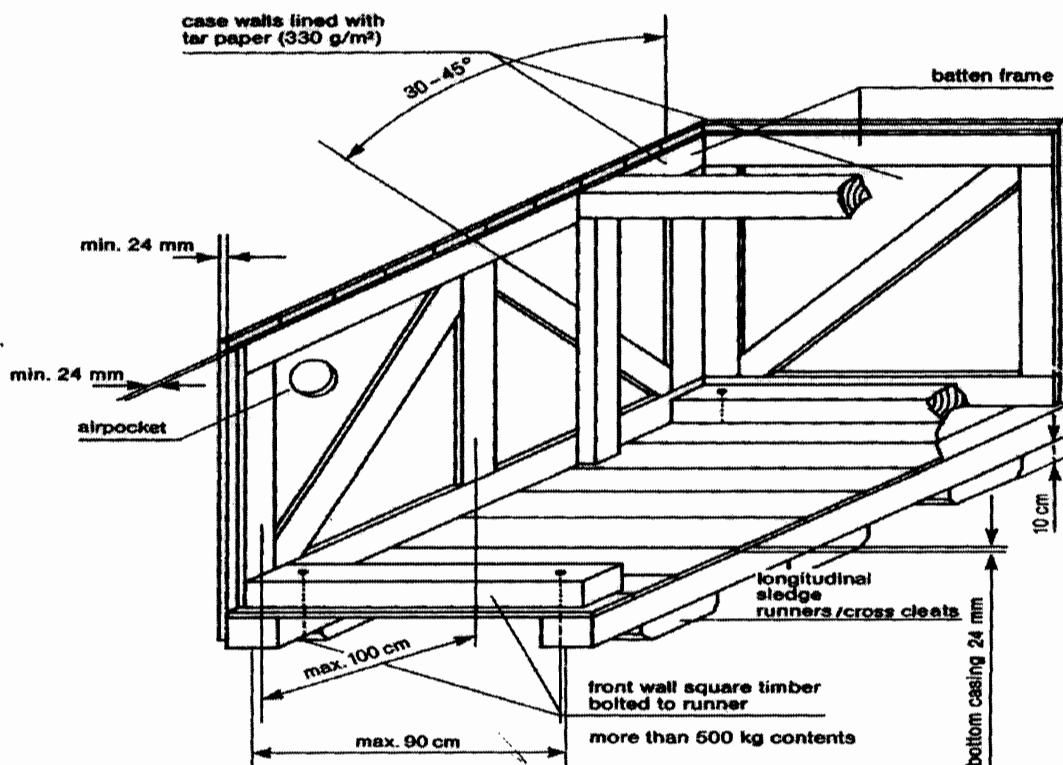
### 8.4.2.1 Type of Equipment

*Recommended for equipment and mechanical parts Equipment sensitive to mechanical damage or parts and components that are particularly at risk of theft or loss; pumps, elbows, flanges, fittings, tools, erection materials, etc.*

### 8.4.2.2 Type of Construction

The same type of construction as article 8.4.1.2, but with all sides completely boarded without space between the boards. Sides to be provided with waterproof lining; fabric-reinforced waterproof tar paper or polyethylene-foils resistant to ultraviolet rays can be used. Polyethylene-foil shall be fixed under the lid cover to avoid penetration of water. At weights of more than 500 kg the longitudinal runner must be bolted to the front all square timber. For ventilation inside the case, an opening in the waterproof lining must be placed between the diagonal battens and diagonal joists.

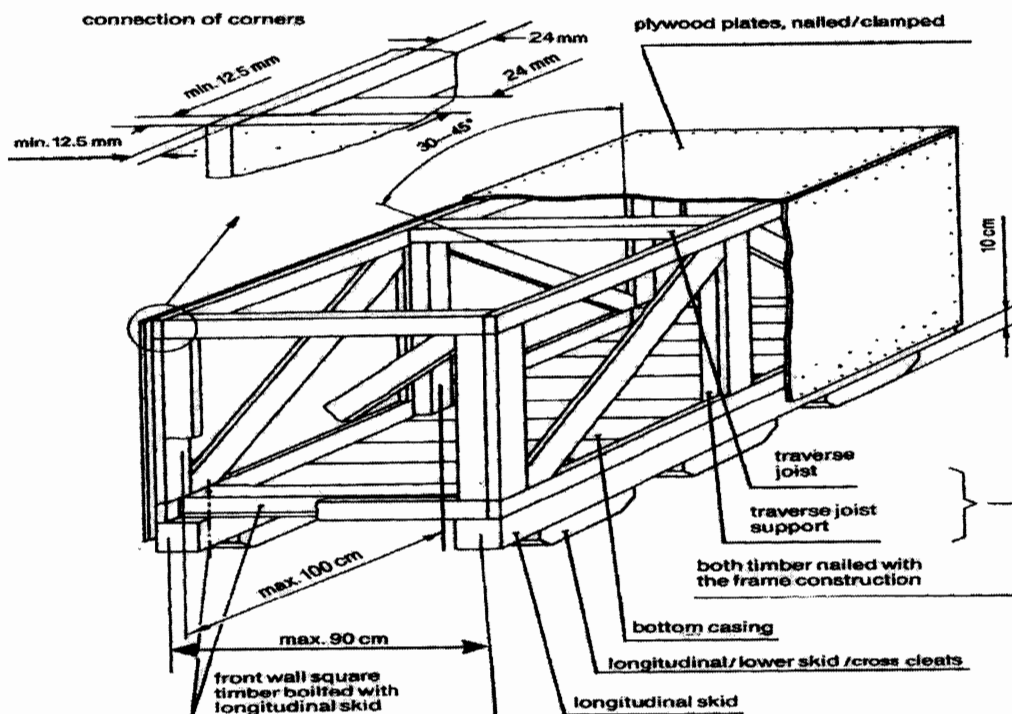
### Packing Category IV



## 8.4.3 Cases with Alternative Surface Materials

### 8.4.3.1 Plywood Box – Packing Category IV A

|  |                                                                                                  |                                      |                 |
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Case constructed of 5 layers of watertight, glued plywood with a total thickness of 12.5 mm. The frame must be constructed from minimum 24 mm timber or as per guide lines given above against clause 8.0, Fig 1 to 11 and must be suitable for the weight and nature of the parts to be packed. Planed square timber must be bolted with longitudinal skid and covered with diagonal joists. If applicable, construction of the cover and sides is to include diagonal bracing. Covers consisting of several layers of plywood are to be sealed with durable elastic putty or additional water-resistant sheets to be fixed.

#### 8.4.4 Case with Barrier Material – Polyethylene Foil – Packing Category V

##### 8.4.4.1 Type of Equipment

Sensitive equipment, simple electrical equipment, insulation materials, fire-resistant materials, with non-corrosion- guarantee for a period up to twelve (12) months.

##### 8.4.4.2 Type of Construction

Preservation by welding in polyethylene-foil with addition of desiccants and if necessary, application of non-corrosive contact agents, otherwise, type of construction as indicated in article 8.4.2.2.

Additional marking:

- Case with desiccants.

#### 8.4.5 Case with Barrier Material – Aluminium Compound Foil – Packing Category VI

##### 8.4.5.1 Type of Equipment

|                                                                                   |                                                                                                  |                                      |                 |
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Electrical equipment such as, switchboards, electric motors, sensitive equipment, with non-corrosion guarantee, for a period up to twelve (12) months.

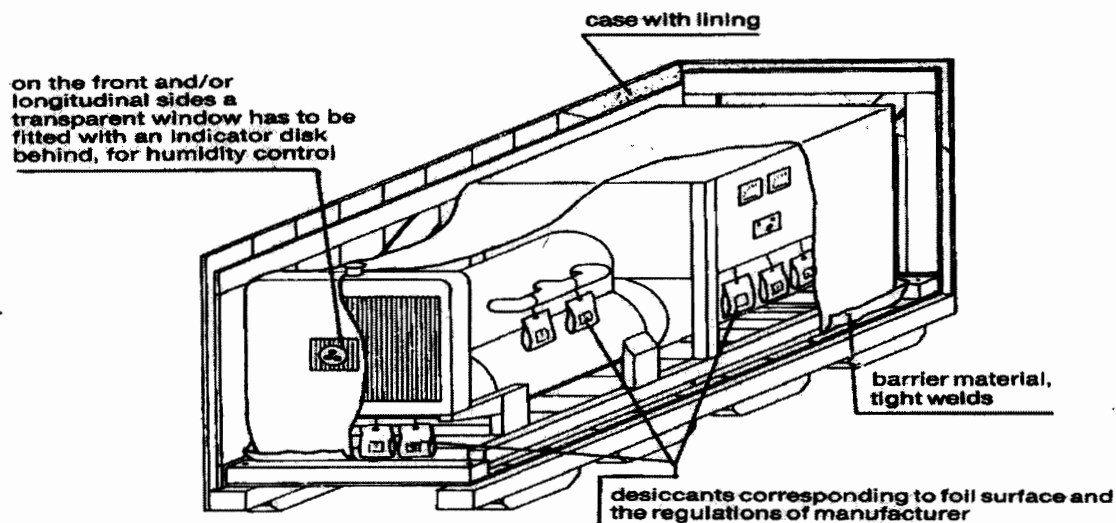
#### 8.4.5.2 Type of Construction

Type of construction as indicated in article 8.4.2.2. Preservation by sealing an aluminium compound foil, with the addition of desiccants. Humidity indicators, if required and installed in the barrier wrapping, shall allow easy control from the outside.

Additional marking:

- Case with desiccants.

#### Packing Category V/VI



#### 8.4.6 Double Case – Packing Category VII

##### 8.4.6.1 Type of Equipment

GOODS which are of high sensitivity to shock, impact and vibration, for instance, special electrical equipment like computers, switchboards, laboratory instruments

##### 8.4.6.2 Type of Construction

Case construction as indicated in article 8.4.2.2, with additional floating inner packing (case-in-case principle), padding corresponding to weight and sensitiveness. Preservation by sealing in aluminium compound foil with the addition of desiccants. The inner case has to be made of plywood or equivalent material with a thickness of 8-12 mm, depending on the weight of the GOODS to be packed. The inner buckles and/or frame borders have to be dimensioned so that the full stability of the inside case will be reached and no twisting is possible. The inner sides of the inside case will be lined with bituminous kraft paper on all sides (except bottom).

|                                                                                   |                                                                                                  |                                      |                 |
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#### **8.4.7 Cable Drum – Packing Category VIII**

##### **8.4.7.1 Type of Equipment**

All type of cables, wires, ropes, hoses.

##### **8.4.7.2 Type of Construction**

For all type of cables refer clause no. 11.1. For other items (wires, ropes, hoses) new or practically new drums are to be used. Planking of the e drums by use of boards, thickness minimum 20 mm, with additional double steel strapping, nailed, and carefully preserved/protected cable ends prior to packing.

#### **8.4.8 Hazardous Materials – Packing Category IX**

##### **8.4.8.1 Type of Equipment**

Hazardous materials according to the law are explosives, compressed gases, liquefied gases dissolved under pressure or deeply refrigerated, flammable liquids, flammable solids: substances liable to spontaneous combustion; substances which, on contact with water, emit flammable gases, oxidizing substances, organic peroxides, poisonous (toxic) and infectious substances; radioactive materials, corrosives, miscellaneous dangerous goods.

##### **8.4.8.2 Type of Construction**

Hazardous materials shall always be packed and documented separately from any other material. Selection of packaging materials, execution of packing and marking as well as documentation shall always be in compliance with the applicable laws and regulations. Any certificates required for transportation or for authorities to be supplied before shipment of the GOODS.

#### **8.4.9 Wooden Floor as a Transport Support – Packing Category X**

##### **8.4.9.1 Type of Equipment**

Any materials to be stuffed in containers or on flat racks and that are not stowed on standard pallets or otherwise suitably packed

##### **8.4.9.2 Type of Construction**

- Longitudinal internal square timbers bolted to the front wall runners, longitudinal skid.
- Maximum distance between longitudinal runners 90 cm (middle to middle of the runner).
- Full boarding of the floor.
- Attaching of lifting lugs and/or iron ropes for lifting/pulling the units off the transport equipment.
- If applicable, preservation of the equipment by sealing in polyethylene-foil or aluminium compound foil and the addition of desiccants.

#### **8.5 Air Transport Packing**

##### **8.5.1 General**

Certain types of material may have to be shipped by air from their country of origin. This means of transport will be exceptional, and will be used only:

- For GOODS, which are highly sensitive to shock or vibrations, such as computers, electronic instruments, or those of small dimensions and weight.
- For GOODS urgently required at the module yard(s) and/or jobsite.



|                                                                                   |                                                                                                  |                                             |                 |    |
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### 8.5.2 Type of Packing

Depending on the goods to be packed, VENDOR may use one of the following types:

- A triple-corrugated cardboard container made with waterproofed glue and a barrier layer of polyethylene on the outsides to keep out humidity.
- Wooden/cardboard packing cases: the wood being used for the framework and base of the cases, waterproofed triple-corrugated cardboard being used for the sides and top. These cases are of the "Bell" type, and used for material of small or medium dimensions.
- For larger dimensions, plywood cases are acceptable. The timber characteristics, cross-sections and thickness will be systematically determined by the nature of the loads to be packed.

### 8.5.3 Dimensions

In order to optimize the existing transport facilities (passenger or cargo aircraft), the dimensions of:

- Triple-corrugated containers.
  - Wooden/cardboard packing cases.
  - Plywood cases.
- Are to be adapted to pallets used for air transportation.

## 9.0 Detailed specification for Wooden Crates/Boxes/Cases and other packing materials

### 9.1 Technical specification for wood

The wood shall be Fir, Chir, Silver Oak (Gravillea Robusta), chemically treated mango and Pinewood with moisture content not exceeding 50%. The wood shall have flexural and compressive strength, stiffness, shock absorption and nail retention properties. The wood shall be free from common defects such as warp, bone, twist, knot, cracks, splits, end splits, bend, visible sign of infection and any kind of decay caused by insects or fungus, etc. Surface cracks with maximum depth of 3mm are permissible. A continuous crack of any depth all along the length is not allowed.

### 9.2 Chemical Treatment of Wood:

The wood shall be chemically treated to provide protection against deterioration due to fungi and attack by termites, borers, marine organism and any other kind of infection. It shall be treated only after final processing like cutting, planning, joint grooving, etc.

### 9.3 TYPE, DESIGN & DIMENSION OF WOODEN PACKING CASES:

#### 9.3.1 PACKING OF EQUIPMENTS

Various mechanical, electrical and C&I equipment e.g. Pumps, motors, equipment skids, heat exchangers, control panels, switch gears, transformers, etc. shall be wrapped in weather proof packing and then secured in wooden packing cases. The construction of wooden packing cases/crates shall be as per details given below and also given in figure 1 to 11.

##### 9.3.1.1 Bottom Frame

|                                                                                   |                                                                                                  |                                             |                 |
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The construction of bottom frame shall be as per Fig-2. The No. of slides/runners for bottom frames shall be selected depending upon the weight and overall dimensions of the load to be carried. The equipment shall be secured by fixing their base frame/plate with the help of bolt and nuts etc. to bottom frame of the wooden packing cases/crates. The equipment not provided with base frame/plate like cylindrical vessels, etc to be secured to the bottom frame of the wooden cases with "C" clamps fabricated from steel channels/ angle iron.

#### 9.3.1.2 TOP FRAME

The construction of top frame shall be as per fig-3.

#### 9.3.1.3 END PANELS

The dimension of the end and lateral panels shall be calculated according to overall dimensions of the items to be packed. Diagonal braces shall be used for packing cases having height exceeding 500mm. Details of bracings shall be as per fig 5 to 9.

#### 9.3.1.4 Sling Plate

To facilitate lifting of cases, longitudinal under slide boards shall be fixed. To avoid damage to the box while lifting sling plates shall be provided. Refer fig-11.

#### 9.3.1.5 Angle Iron Cleats

Angle iron cleats shall be used for strengthening the joints as indicated in fig-10

#### 9.3.1.6 Other Requirements

- The thickness of planks for top, bottom, side and end panels shall be at least 25mm. Planks used for this purpose shall be joined with each other by tongue and groove joint. The groove dimension shall be such that tongue fits tightly into groove to make the joint.
- Runners/slides, traverse bars, etc shall be of single length i.e. without any joint. Planks for sheathing, diagonal bracing etc shall also be of single length up to 2400mm, proper jointing is permitted for planks for sheathing and diagonal bracings.
- Each equipment to be individually covered with double polyethylene petticoat. Sheet thickness of polythene sheet shall not be less than 0.175 mm (175 microns). The sealing shall be such so as not to allow moisture inside.
- The inner surface of 4 sides of shooks shall be nailed with bituminized water proof craft paper. Wherever 2 pieces of kraft paper are used, joint shall have an overlap of minimum 20 mm.
- All the inner sides of the box shall be nailed with bitumen coated HESSIAN POLYTHYLENE KRAFT PAPER. For top frame it shall project on all sides by 100mm and shall be nailed on sides. Wherever 2 pieces of kraft paper are used, joint shall have an overlap of minimum 20 mm.
- For delicate equipment like control panels and switchgears, lighting panels and lighting transformers, suitable cushioning material like rubberised coir (min. 50 mm thick and 100 mm wide) shall be provided on their bottom support and the gap between the panel and casing

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shall be filled with rubberized coir with distance between consecutive supports less than 500 mm (ref fig15). For other equipment suitable support from sides of the casing shall be provided.

- Switchgear cubicles, control panels and control desks shall be packed and shipped in separate convenient sections. The components e.g. circuit breakers relays and instruments etc. which are removed from panels for shipping purpose and shall be separately packed and shipped as per packing instructions in clause 10.4.
- Packing case for control panels and switchgear panels shall be finally covered with GI sheet of minimum thickness of 0.4mm.
- Packing cases shall be bound at edges by nailing MS clamps/brackets at sufficient intervals. Further heavier boxes shall be strapped with C clamps (ref fig-4) fabricated from steel channels/angles and lighter boxes shall be strapped with hoop iron strips.
- Silica gel is used for this purpose to protect contents over sufficiently long time from corrosion. Silica gel shall be indicating type confirming to IS-304 (1979) packed in cotton bags placed at different positions inside the packing for absorbing moisture and shall not come into directly contact with equipment/material inside the package. The quantity of silica gel shall be adequate for storage period of one year, however it shall not be less than 4 gm. per ltr. Volume of case subject to minimum 400 gm. Per case.



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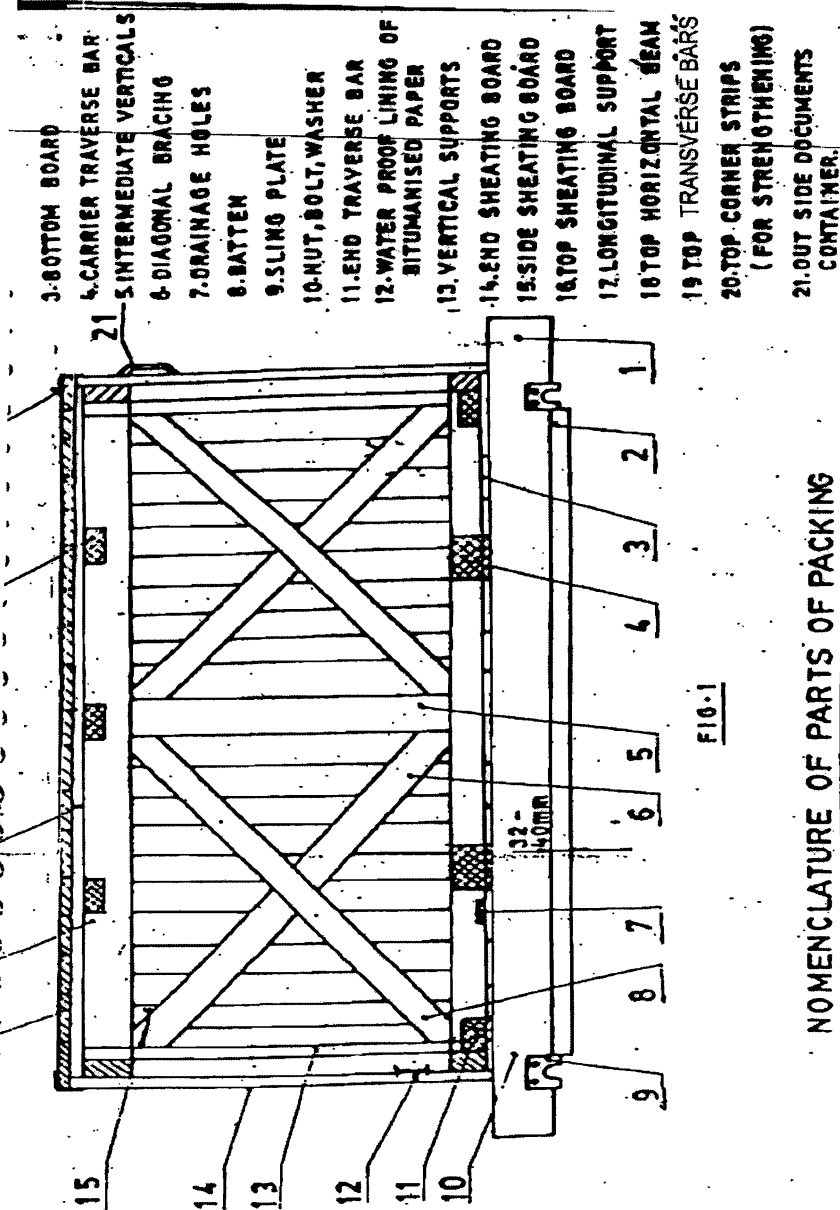


FIG-1

## NOMENCLATURE OF PARTS OF PACKING

### CASES

FIG-1

1 SLIDE  
2 UNDER SLIDE BOARD

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## BOTTOM FRAME ARRANGEMENTS

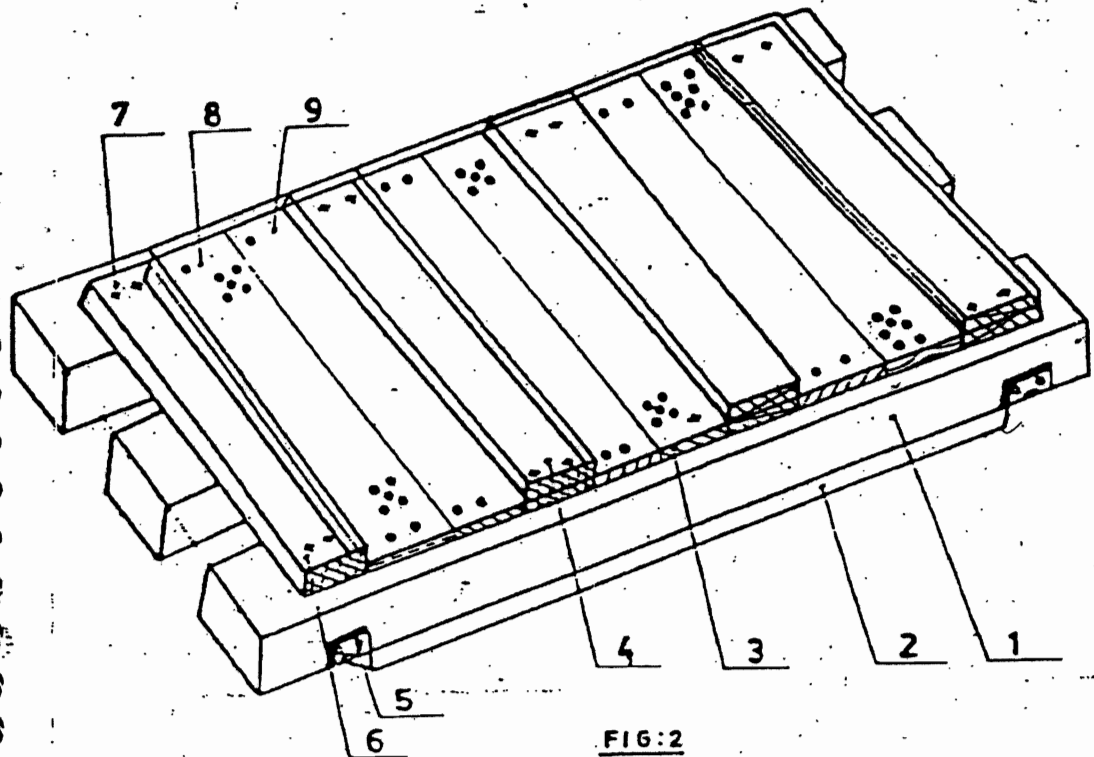


FIG:2

Nos. of slides: Minimum 2 Nos.  
For length more than 1800 mm or  
load more than 1000kg, Nos. of  
slides shall be minimum 3 Nos.  
For dimensions of slides, refer Table 1  
Cross section of end transverse bar; 100x100 mm.  
(minimum)

1. SLIDE
2. UNDER SLIDE BOARD
3. BOTTOM BOARD
4. CARRIER TRAVERSE BAR
5. SLING PLATE
6. TRAVERSE BAR
7. BOLT, NUT & WASHER
8. DRAINAGE HOLES
9. NAILS

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## TOP FRAME ARRANGEMENT

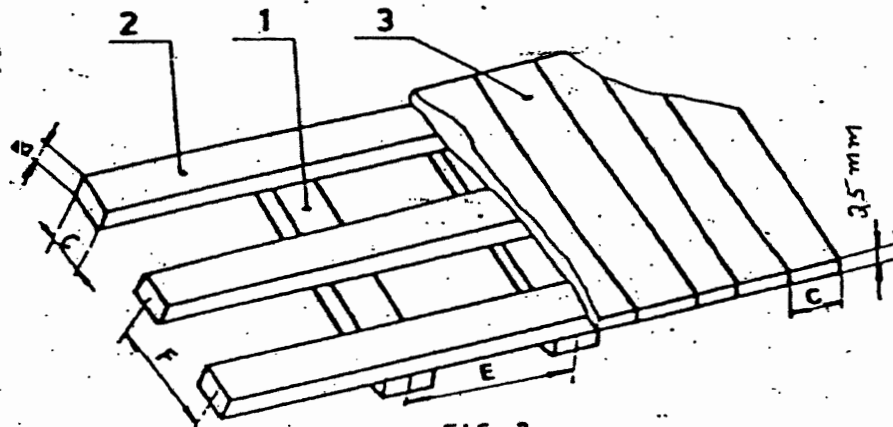
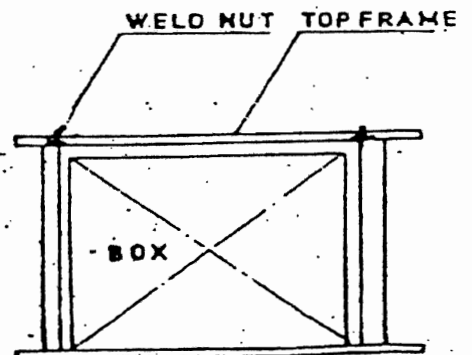
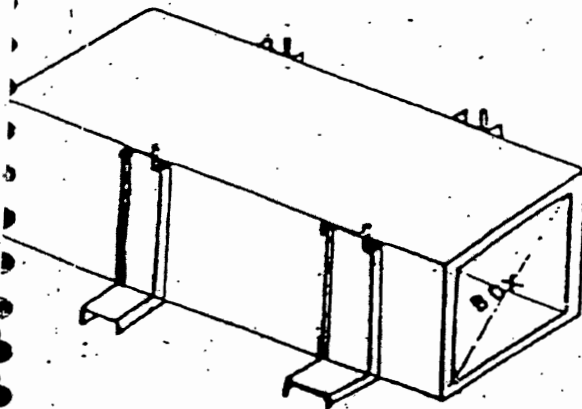


FIG-3

F : 700 to 1000 mm  
E : 500 to 900 mm  
30 x 100 mm.

- 1 - Traverse Bars
- 2 - Horizontal Soans
- 3 - Top Board

## ARRANGEMENT OF C-CLAMPS AROUND CASES





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## ARRANGEMENT OF DIAGONAL BRACING AND HORIZONTAL SUPPORT

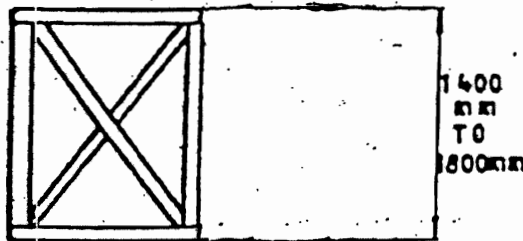


FIG:6

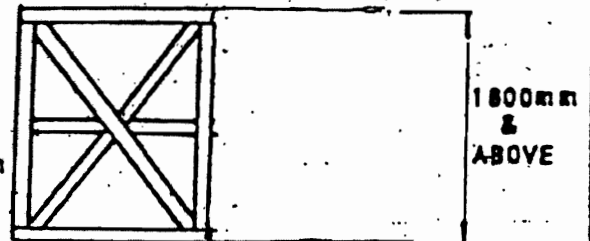


FIG:8

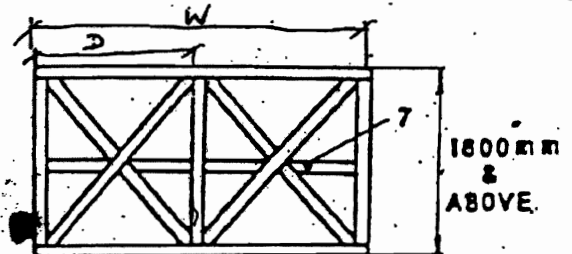


FIG:7

7- Middle Horizontal Support

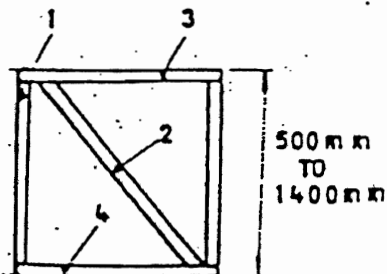


FIG:5

1- Vertical Support

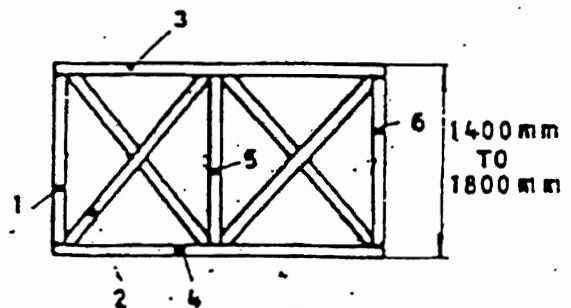


FIG:7

1, 5, 6 - Vertical Support

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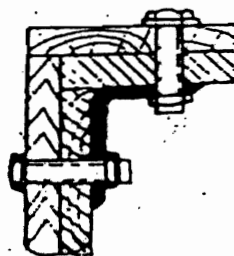
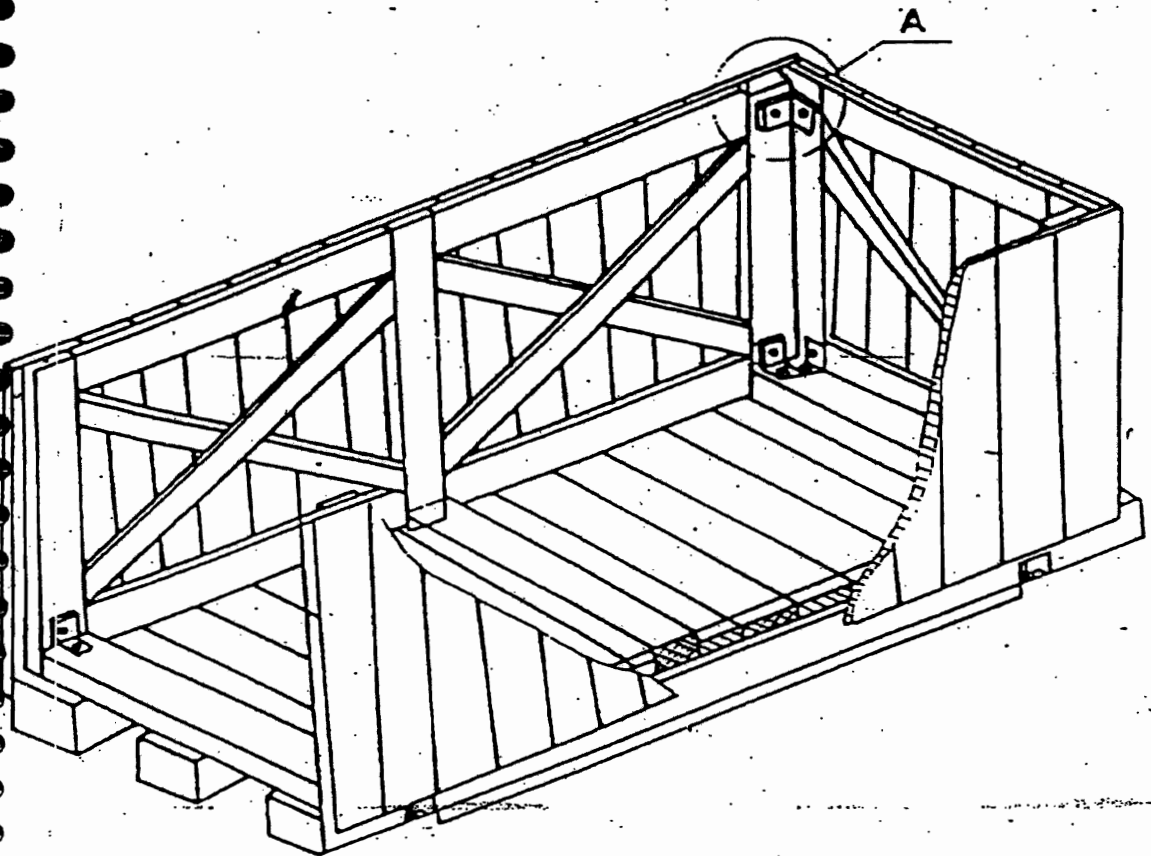
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## ARRANGEMENT OF PACKING CASE



DETAIL-A

HOLE DIAMETER  
MUST CONFORM  
TO BOLT DIA

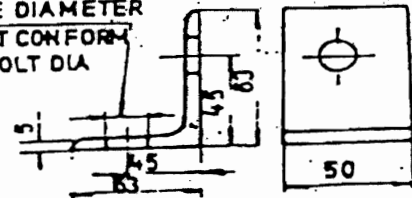


FIG:10

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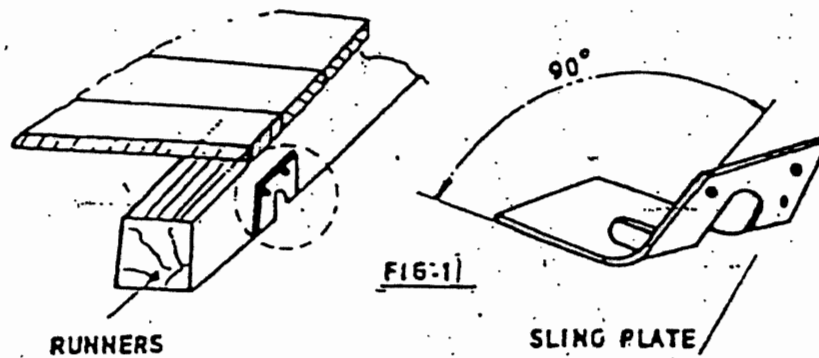
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**ARRANGEMENT OF SLING & PLATE ON  
CASES**

|                                                                                   |                                                                                                  |                                             |                 |
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**TABLE-1**

| LOADS | LENGTHS OF SLIDES      |                 |                 |                 |                                                                                                                               |                 |                 |
|-------|------------------------|-----------------|-----------------|-----------------|-------------------------------------------------------------------------------------------------------------------------------|-----------------|-----------------|
|       | 600                    | 800             | 1000            | 1200            | 1300                                                                                                                          | 1500            | 2000            |
|       | Cross section<br>b x c |                 |                 |                 | <div style="border: 1px solid black; display: inline-block; width: 80px; height: 15px; vertical-align: middle;"></div> c<br>b |                 |                 |
| 500   | 50<br>X<br>100         | 50<br>X<br>100  | 50<br>X<br>100  | 50<br>X<br>100  | 75<br>X<br>100                                                                                                                | 75<br>X<br>100  | 100<br>X<br>100 |
| 800   | 50<br>X<br>100         | 50<br>X<br>100  | 75<br>X<br>100  | 75<br>X<br>100  | 75<br>X<br>100                                                                                                                | 75<br>X<br>100  | 100<br>X<br>100 |
| 1000  | 75<br>X<br>100         | 75<br>X<br>100  | 75<br>X<br>100  | 100<br>X<br>100 | 100<br>X<br>100                                                                                                               | 100<br>X<br>110 | 100<br>X<br>150 |
| 1500  | 75<br>X<br>100         | 75<br>X<br>100  | 100<br>X<br>100 | 100<br>X<br>100 | 100<br>X<br>100                                                                                                               | 100<br>X<br>150 | 100<br>X<br>150 |
| 2000  | 75<br>X<br>100         | 100<br>X<br>100 | 100<br>X<br>100 | 100<br>X<br>150 | 100<br>X<br>150                                                                                                               | 100<br>X<br>150 | 150<br>X<br>150 |
| 2500  | 75<br>X<br>100         | 100<br>X<br>100 | 100<br>X<br>150 | 100<br>X<br>150 | 100<br>X<br>150                                                                                                               | 150<br>X<br>150 | 150<br>X<br>150 |
| 3000  | 100<br>X<br>100        | 100<br>X<br>150 | 150<br>X<br>150 | 150<br>X<br>150 | 150<br>X<br>150                                                                                                               | 150<br>X<br>150 | 150<br>X<br>150 |

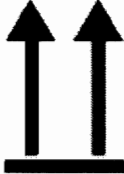
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**Table-2**

| End and side panels | Width of the panel "W" | Distance between longitudinal support (Dimension "D") |     |      |      |             |      |      |
|---------------------|------------------------|-------------------------------------------------------|-----|------|------|-------------|------|------|
|                     |                        | 600                                                   | 800 | 1000 | 1200 | 1400        | 1600 | 1800 |
|                     |                        | Cross section<br>b x c                                |     |      |      | Item 1 to 7 |      |      |
| Fig- 5 to Fig-9     | 600 to 1200            | 30                                                    | 30  | 30   | 30   | 30          | 30   | 30   |
|                     |                        | X                                                     | X   | X    | X    | X           | X    | X    |
|                     | 1201 to 1600           | 100                                                   | 100 | 100  | 130  | 130         | 130  | 130  |
|                     |                        | 30                                                    | 30  | 30   | 30   | 30          | 30   | 30   |
|                     | 1601 to 2000           | X                                                     | X   | X    | X    | X           | X    | X    |
|                     |                        | 130                                                   | 130 | 130  | 130  | 130         | 130  | 130  |
|                     | 2001 to 3000           | 30                                                    | 30  | 30   | 30   | 30          | 30   | 40   |
|                     |                        | X                                                     | X   | X    | X    | X           | X    | X    |
|                     | 3001 to 4000           | 130                                                   | 130 | 130  | 130  | 130         | 130  | 150  |
|                     |                        | 40                                                    | 40  | 40   | 40   | 40          | 40   | 40   |
|                     |                        | X                                                     | X   | X    | X    | X           | X    | X    |
|                     |                        | 150                                                   | 150 | 150  | 150  | 150         | 150  | 150  |

|                                                                                   |                                                                                                  |                                             |                 |
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#### INDICATION MARKS ON CASES/BOXES/CRATES

| Designation                               | Symbol                                                                              | Explanation                                                                                                                                                                                                                                                                                                                |
|-------------------------------------------|-------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Fragile, Handle with care                 |    | The symbol should be applied to easily broken cargoes. Cargoes marked with this symbol should be handled carefully and should never be tipped over or slung.                                                                                                                                                               |
| Use no hooks                              |    | Any other kind of point load should also be avoided with cargoes marked with this symbol. The symbol does not automatically prohibit the use of the plate hooks used for handling bagged cargo.                                                                                                                            |
| Top                                       |   | The package must always be transported, handled and stored in such a way that the arrows always point upwards. Rolling, swinging, severe tipping or tumbling or other such handling must be avoided.                                                                                                                       |
| Keep away from heat (solar radiation)     |  | Compliance with the symbol is best achieved if the cargo is kept under the coolest possible conditions. In any event, it must be kept away from additional sources of heat. It may be appropriate to enquire whether prevailing or anticipated temperatures may be harmful.                                                |
| Protect from heat and radioactive sources |  | Stowage as for the preceding symbol. The cargo must additionally be protected from radioactivity.                                                                                                                                                                                                                          |
| Sling here                                |  | The symbol indicates merely where the cargo should be slung, but not the method of lifting. If the symbols are applied equidistant from the middle or center of gravity, the package will hang level if the slings are of identical length. If this is not the case, the slinging equipment must be shortened on one side. |
| Keep dry                                  |  | Cargo bearing this symbol must be protected from excessive humidity and must accordingly be stored under cover. If particularly large or bulky packages cannot be stored in warehouses or sheds, they must be carefully covered with tarpaulins.                                                                           |

|  |                                                                                                  |                                             |                 |
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|--------------------------------|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Center of gravity              |  | This symbol is intended to provide a clear indication of the position of the center of gravity. To be meaningful, this symbol should only be used where the center of gravity is not central. The meaning is unambiguous if the symbol is applied onto two upright surfaces at right angles to each other.                            |
| No hand truck here             |  | The absence of this symbol on packages amounts to permission to use a hand truck on them.                                                                                                                                                                                                                                             |
| Stacking limitation            |  | The maximum stacking load must be stated as "... kg max.". Since such marking is sensible only on packages with little loading capacity, cargo bearing this symbol should be stowed in the uppermost layer.                                                                                                                           |
| Clamp here                     |  | Stating that the package may be clamped at the indicated point is logically equivalent to a prohibition of clamping anywhere else.                                                                                                                                                                                                    |
| Temperature limitations        |  | According to regulations, the symbol should either be provided with the suffix "...°C" for a specific temperature or, in the case of a temperature range, with an upper ("...°C max.") and lower ("...°C min.") temperature limit. The corresponding temperatures or temperature limits should also be noted on the consignment note. |
| Do not use forklift truck here |  | This symbol should only be applied to the sides where the forklift truck cannot be used. Absence of the symbol on other sides of the package amounts to permission to use forklift trucks on these sides.                                                                                                                             |
| Electrostatic sensitive device |  | Contact with packages bearing this symbol should be avoided at low levels of relative humidity, especially if insulating footwear is being worn or the ground/floor is nonconductive. Low levels of relative humidity must in particular be expected on hot, dry summer days and very cold winter days.                               |

|                                                                                   |                                                                                                  |                                             |                        |
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|                        |                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                               |
|------------------------|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Do not destroy barrier |  | A barrier layer which is (virtually) impermeable to water vapor and contains desiccants for corrosion protection is located beneath the outer packaging. This protection will be ineffective if the barrier layer is damaged. Since the symbol has not yet been approved by the ISO, puncturing of the outer shell must in particular be avoided for any packages bearing the words "Packed with desiccants". |
| Tear off here          |  | This symbol is intended only for the receiver.                                                                                                                                                                                                                                                                                                                                                                |

**FIG-12**

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|                             |                                                            |
|-----------------------------|------------------------------------------------------------|
| BHEL-PEM-DELHI-INDIA        |                                                            |
| CONSIGNEE                   |                                                            |
| MATERIAL                    |                                                            |
| CUSTOMER REF.               | MO. NO.                                                    |
| DESPATCH<br>ADVICE NOTE NO. | CASE NO.                                                   |
| DIMENSIONS(MM)<br>LXBXH     | NET<br>WT -KGS                                             |
|                             | GROSS<br>WT -KGS                                           |
| SPECIAL<br>INSTRUCTIONS     | HANDLE WITH CARE -- KEEP DRY<br>DO NOT DROP -- DO NOT TILT |

FIG-13: MARKING PLATE



# TITLE

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FOR SEAWORTHY PACKING  
FOR EXPORT JOBS

SPECIFICATION NO. PE-TS-888-100-A001

VOLUME II B

SECTION D

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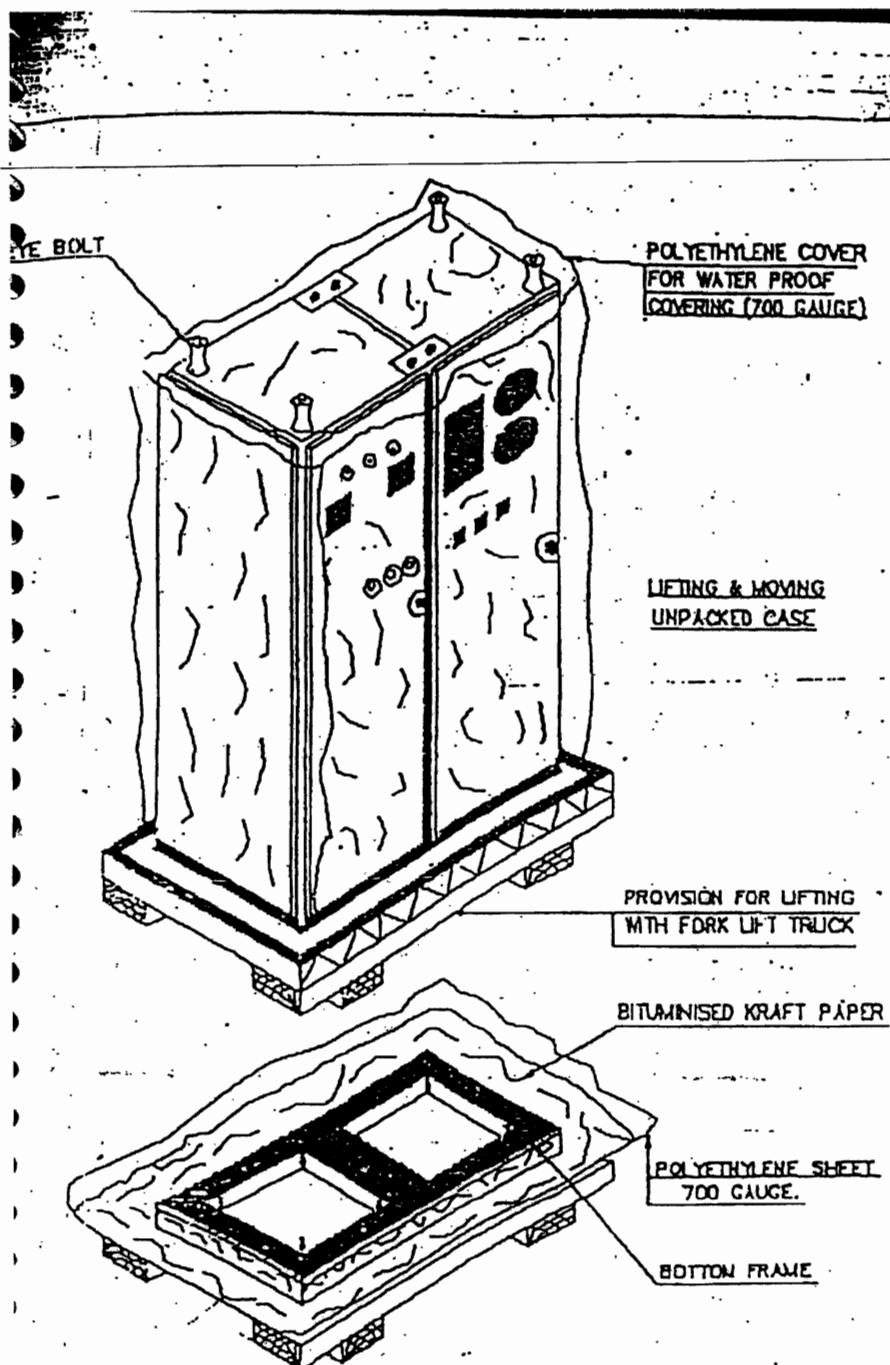


FIGURE-14





# TITLE

## TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS

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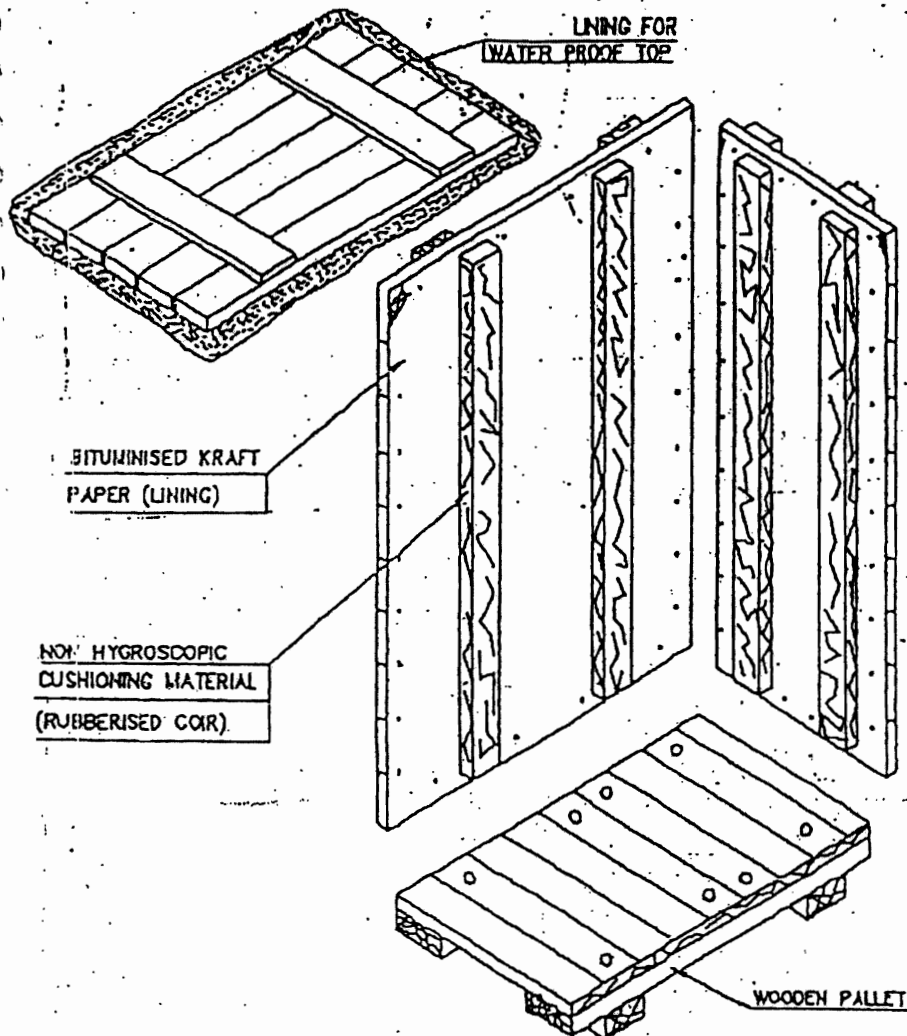
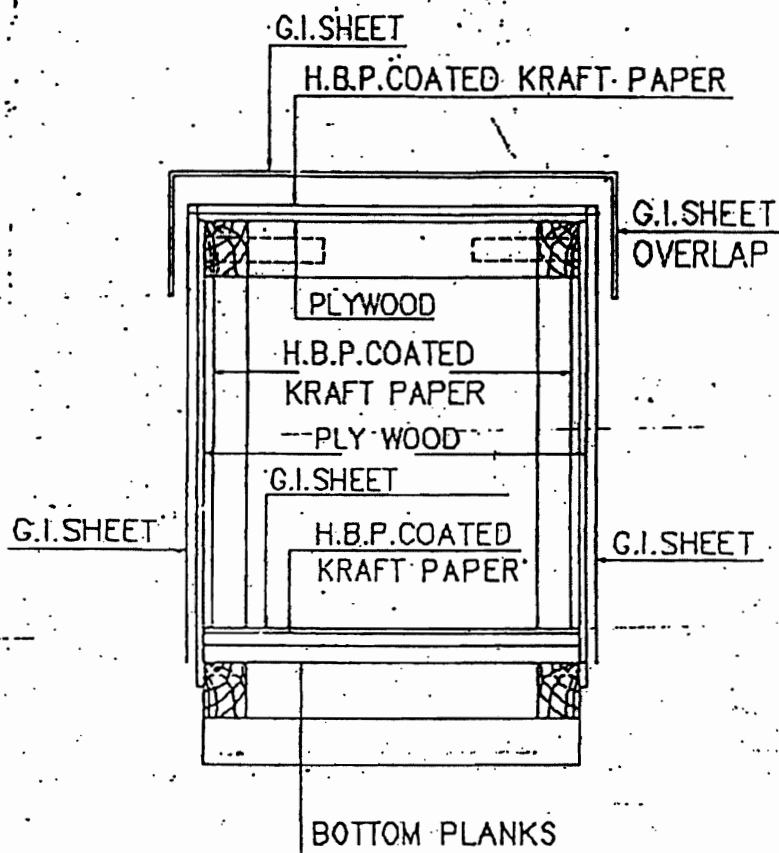


FIGURE-15

|                                                                                   |                                                                                                  |                                      |                 |
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**FIG-16 : CLOSED PACKING CASE WITH G.I.SHEET  
SHOWING LAYERS OF PACKING MATERIALS.**

|                                                                                   |                                                                                                  |                                             |                 |
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## 10.0 TYPICAL PACKING DETAILS/PROCEDURE FOR MECHANICAL ITEMS

### 10.1 INSULATION MATERIAL (MINERAL WOOL MATTRESSES)

This specification covers the requirements of seaworthy packing and marking for bonded mineral (rock) wool mattresses having metallic hexagonal wire netting as facing on one or both sides.

#### 10.1.1 TYPE OF CONSTRUCTION

Mattress shall be packed in Polythene (of 0.2 mm thickness) all around and sealed to prevent moisture absorption during transit and storage. Further it shall be wrapped with Bitumen coated Polythene bonded/lined Hessian and stitched and then packed in 5 ply DFC carton box.

Silica gel is used for this purpose to protect contents over sufficiently long time from corrosion. Silica gel shall be of indicating type conforming to IS:304-1979 packed in cotton bags placed at different positions inside the packing for absorbing moisture and shall not come into direct contact with the material inside the package. The quantity of silica gel shall be enough for storage period of one year. However, it shall not be less than 4 gms per litre volume of case subject to minimum of 400 gms per case.

Each mattress as well as the packages shall be serial numbered. Also, printed sheets indicating the nominal thickness, density and wire netting details (i.e. material and size) shall be placed below the wire netting.

Following details shall be legibly written on the packages. The details shall also be typed on a sheet of paper & kept in a sealed Polythene cover, inside the packages

- a) Project Name
- b) Purchase Order No.
- c) Sl. No. of package
- d) Size of mattress (Thickness x Length x Width)
- e) Density
- f) Wire netting material and size
- g) Weight of the package

### 10.2 INSULATION MATERIAL (ALUMINIUM COIL)

Heavy Gauge Aluminium Coil Packaging are done by Eye-to-Sky packaging or by Eye to eye packaging as per the proven practice being followed by manufacturer of Aluminium sheets.

#### 10.2.1 Type of construction for Eye to Sky packaging

- a. Strapping of coil with polyester strap around circumference at one place.
- b. Putting paper I. D. Edge protector.
- c. Wrapping the coil with VCI stretch film after putting silica gel bags (4 nos.) Inside the coil.
- d. Wrapping the coil with HDPE film.
- e. Covering the coil including its build up & bore with masonite / particle board.
- f. Putting metallic I. D on coil.
- g. Putting O.D edge protector (paper) on coil.

|                                                                                   |                                                                                                  |                                             |                 |
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- h. Putting circumferential polyester strap (3 nos.) & eye polyester strap ( 4 nos.).
- i. After placing the coil on coil tilter ply wood (10mm thick) of suitable size along with wooden pallet is to be put at the bottom side of the coil.
- j. Coil is to be tilted to eye-to-sky position.
- k. Final strapping with metallic strap to unit coil and skid at 2 places with top cover of plywood.
- l. Fixing the coil with wooden blocks at 4 corners.
- m. Labeling 2 nos.(one metallic & one adhesivetype) For specification, net wt. & gross wt.

#### **10.2.2 Type of construction for Eye to Eye packaging**

- a. Strapping of coil with polyester strap around circumference at one place.
  - b. Putting paper I. D. Edge protector.
  - c. Wrapping the coil with VCI stretch film after putting silica gel bags (4 nos.) Inside the coil.
  - d. Wrapping the coil with HDPE film.
  - e. Covering the coil including its build up & bore with masonite / particle board.
  - f. Putting metallic I. D on coil.
  - g. Putting O.D edge protector (paper) on coil.
  - h. Putting circumferential polyester strap (3 nos.) & eye polyester strap ( 4 nos.).
  - i. Placing of coil on wooden skid Coil is to be tilted to eye-to-sky position.
  - j. Final strapping of coil and skid at 2 places with steel strap. Fixing the coil with wooden blocks at 4 corners.
- Labeling 2 nos.(one metallic & one adhesive type) For specification net wt. & gross wt.

#### **10.3 Packing Procedure for Online Tube Cleaning System and accessories**

This procedure is applicable for the shipment of Onload Tube Cleaning System and accessories by sea.

##### **10.3.1 Packing details:**

- The Packing case shall be made of treated rubber wood. The design of the case shall be as per Annexure IIIA & IIIB.
- The Equipments shall be placed on the wooden base of the Packing case and fastened if required to arrest the movement of the same.
- Equipment shall be covered by Polythene sheet and inside wall surfaces of the wooden cases also shall be covered by polythene sheet.
- All Nozzles shall be closed with plywood dummies.
- All electrical components assembled or loose shall be covered with polythene sheets along with silica gel pack.
- Silica gel desiccants shall be kept inside each case in sufficient quantities in order to absorb the moisture.

|                                                                                   |                                                                                                  |                                             |                 |
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- Thermocol packing shall be made for glass items like Ball vessel sight glass, Vpiece
- sight glass & pressure gauge.
- Silica gel desiccants shall be kept inside of each case to absorb the moisture.
- A Packing list covered in a polythene envelope shall be fixed inside and outside of each packing case.
- Shipping marks and consignee address shall be painted on the outer surface of the case.
- All handling instruction required for the case like top, sling, rain, handle with care etc, shall be marked on the case as per the symbol attached.
- Machined surface will be applied with Anti rust oil and covered by polyurethane sheet to protect from external oxidation.
- All valves will be closed with dummies to protect the internals and placed in the wooden case which will covered by polyurethane sheet.



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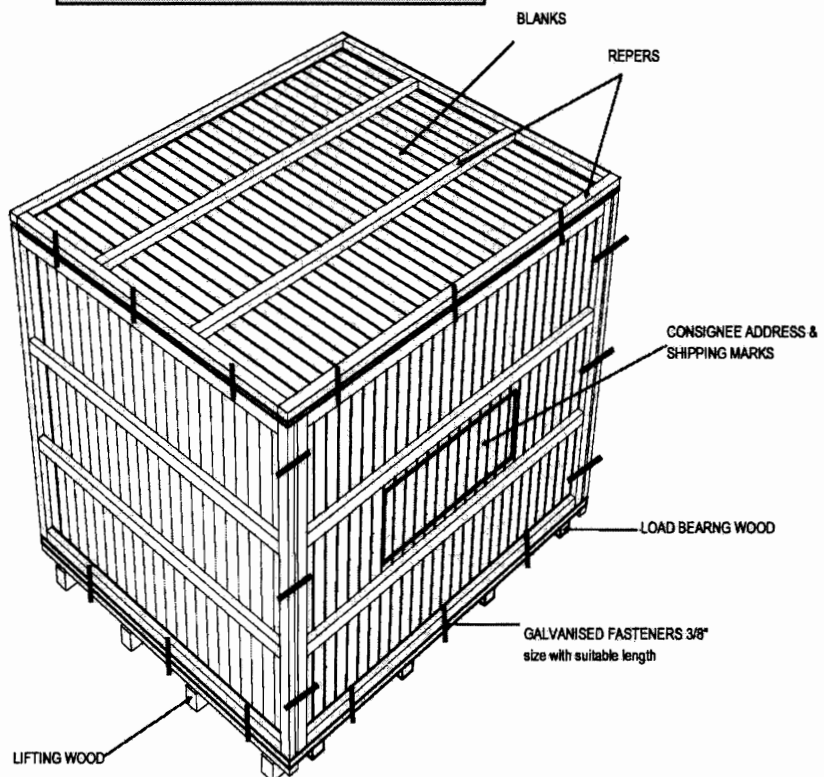
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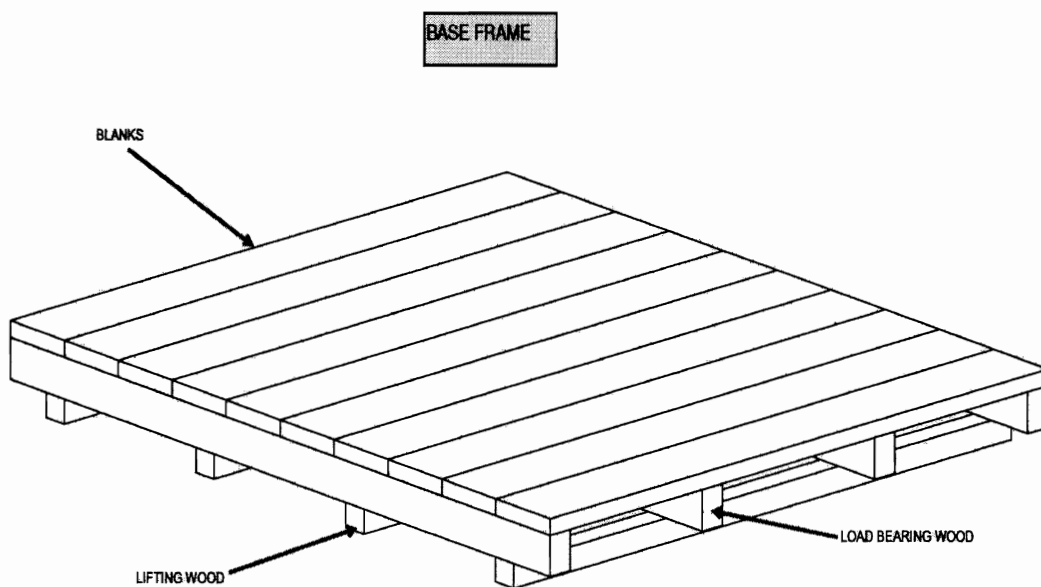
MODEL: FASTNERS TYPE (BASE, SIDE & TOP  
ATTACHED WITH BOLT, NUT & WASHER)

This Type of case to be used for  
following items:

1. BALL SEPERATOR
2. BALL COLECTOR SKID



|                                                                                   |                                                                                                  |                                             |                 |
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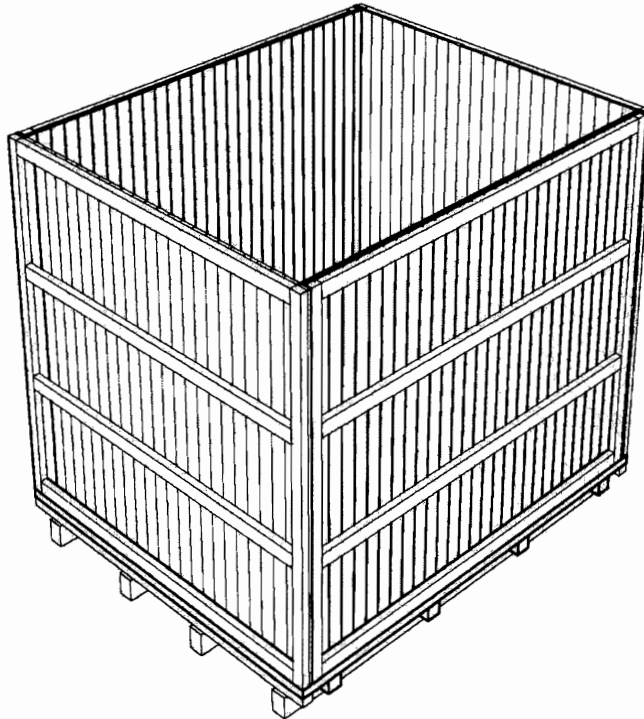
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MODEL: FASTNERS TYPE - WITHOUT TOP







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MODEL: NAILING TYPE  
(FRAME & INSIDE REEFER NAILED)

- THIS TYPE OF CASE TO BE USED FOR THE FOLLOWING ITEMS:
1. PUMP SKID
  2. CONTROL PANEL
  3. LOOSE ITEMS, TOOLS & TACKLES
  4. DPMS, BRM
  5. SPARES
  6. CLEANING BALLS
  7. CABLES & ACCESSORIES

Shipping marks & Consignee  
Address

BLANKS

LIFTING WOOD

BLANKS

REEPERS

BLANKS

REEPERS

LOAD BEARING WOOD

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# TITLE

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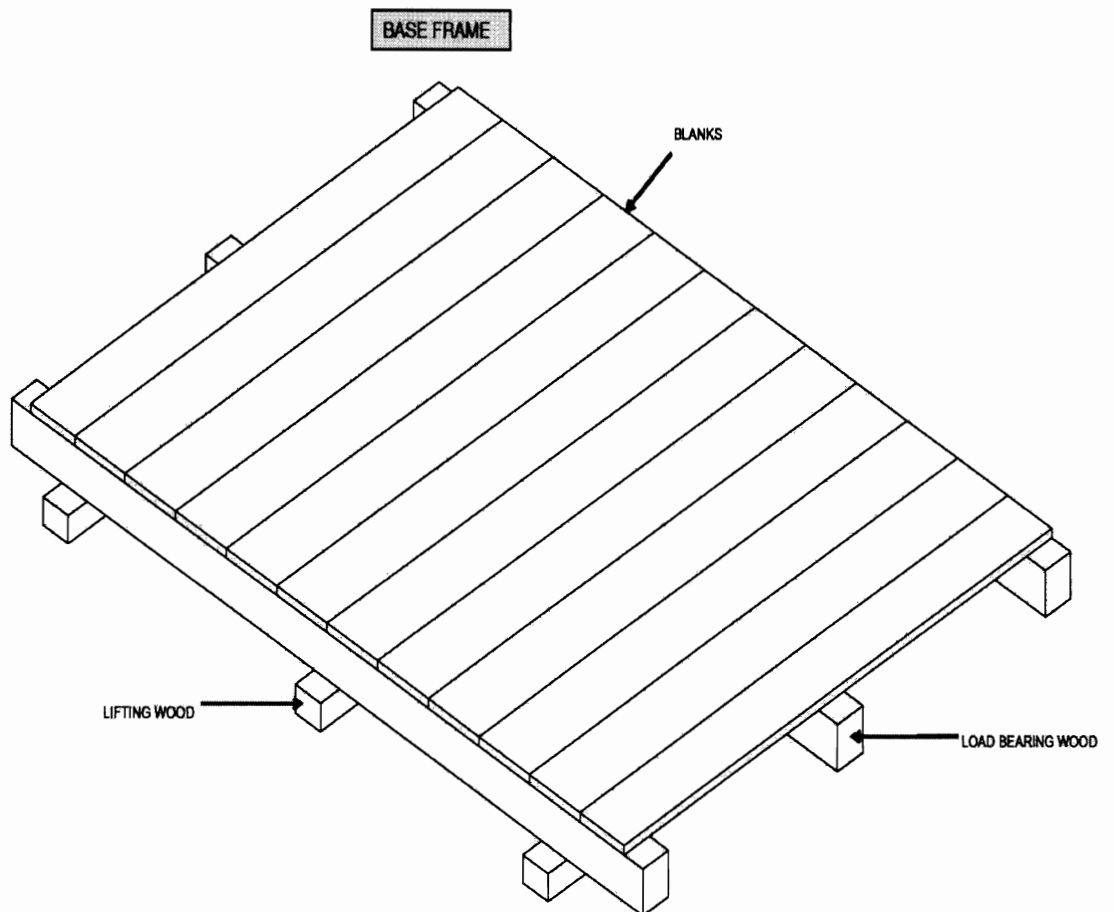
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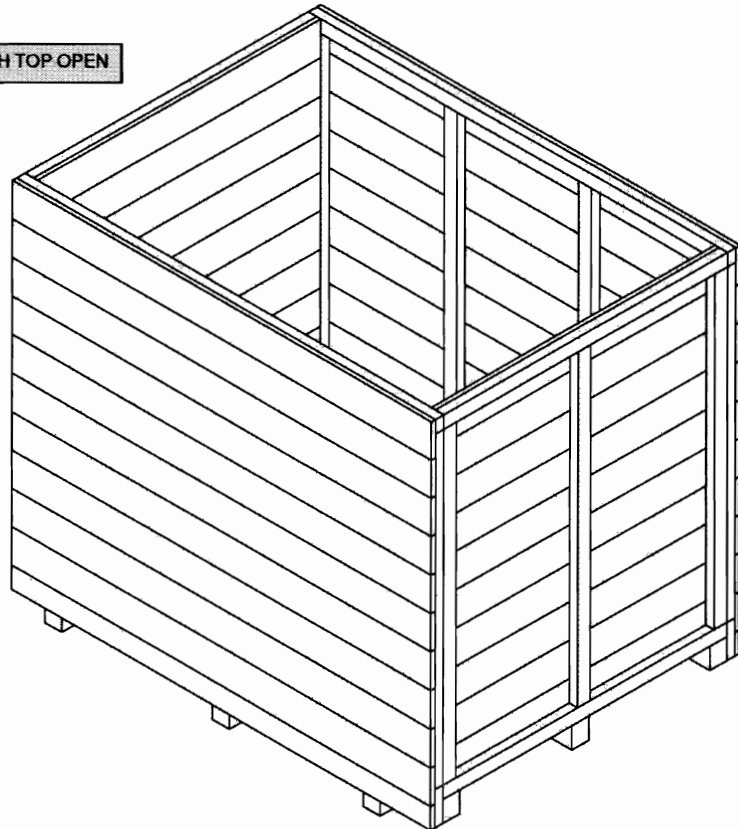
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|                                                                                   |                                                                                                  |                                      |                 |
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#### 10.4 PACKING OF LOOSE ITEMS

Loose mechanical, electrical and C&I items e.g. valves, fittings, pressure/temperature gauges/switches, circuit breakers, relays etc shall be individually wrapped using polyethylene sheets/U foam/ thermocol sheets/air bubble sheets depending upon the items and then packed in wooden boxes. The left out spaces and top of the boxes shall be filled with rubberized coir to get proper cushioning effect, Special attention shall be paid to relays, instruments etc for arresting the movements of their operating mechanism during transportation.

The construction of wooden packing cases shall be as per clause 9.3.1 retaining its all features concerning strength of the box. The construction of wooden packing case for electrical and C&I items shall be as per fig-16.

Inner surface of 6 sides of the box shall be lined with bitumen coated hessian polyethylene kraft paper. Rubberized coir of min. 25mm thickness and 100 mm width shall be nailed to inner surfaces of bottom and 4 sides of the boxes.

#### 11.0 PACKING OF ELECTRICAL ITEMS

##### 11.1 CABLES

**11.1.1 Type of Equipment**  
All type of cables..

##### 11.1.2 Type of Construction

New or practically new cable drums made of steel and painted with epoxy resin paint are to be used. Cable ends are carefully protected before packing. Over the cables polyethylene sheet shall be wrapped and then sealed properly. Cable drum can be put in wooden crates for ease in transportation and handling. (Wooden cable drum is also acceptable, however vendor to furnish constructional details for approval).



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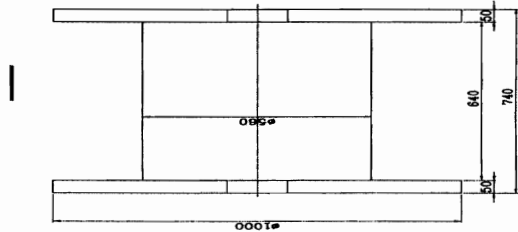
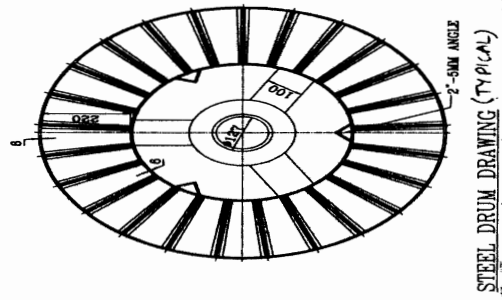
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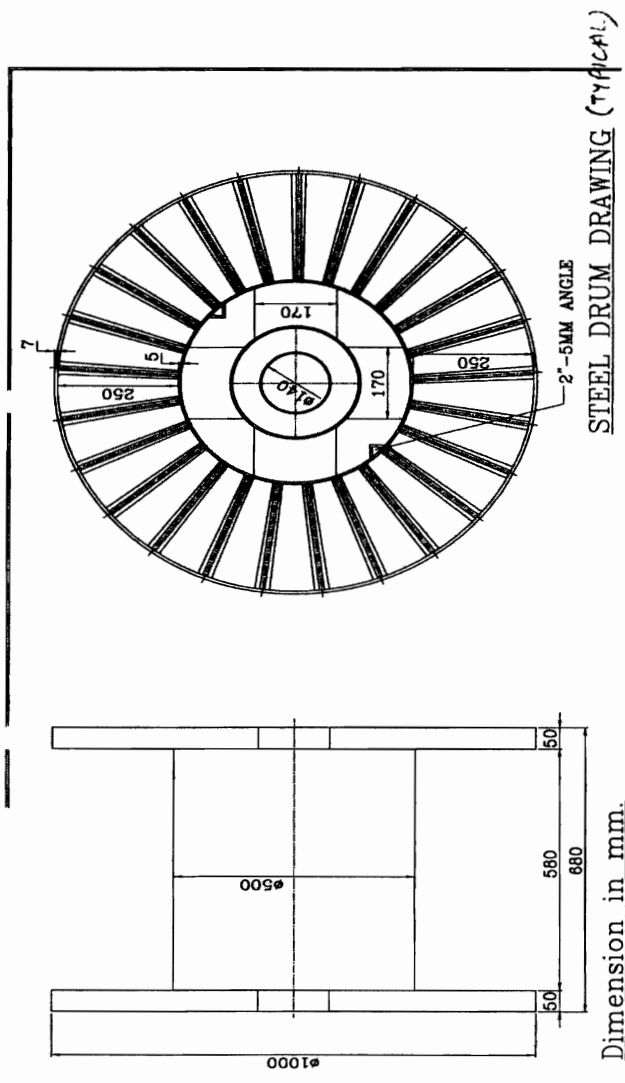
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## 11.2 PACKING OF CABLE TRAYS & ACCESSORIES AND CABLE TRAY SUPPORT MATERIAL

11.2.1 Cable trays can be packed in wooden boxes as per fig 1 to 11 or in steel boxes. Details of steel box construction is as indicated below.

- 1) All Dimensions are in "mm" unless otherwise stated.
- 2) Packing Box shall be fabricated using 50x50x6mm MS Angle, 50x3mm Flat, 2.5 mm thick C Channel, 1mm & 1.6mm Thick sheet.
- 3) Finish of Packing Box Shall be Galvanized.
- 4) Angle & Channel Section forming part of the Main frame shall be welded thoroughly with each other to give a rigid structure.
- 5) Sheet Section and Flat section shall be bolted/ Riveted/ Welded suitably to the Main frame stated in '4' above.

|                                                                                   |                                                                                                  |                                             |                 |
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- 6) Welding Portion on galvanized surfaces shall be painted with Zinc Rich Paint.
- 7) Dispatch details such as consignor/consignee address, contract and case details, 'country of origin, port of delivery, stacking instructions shall be written on one of the side of boxes. An anodized aluminium plate as per details and specifications given in page 3 of 5 shall be provided on the boxes
- 8) One copy of packing slip wrapped in polythylene bag covered with suitable aluminium .packing slip holder to be nailed on the external surface of the box. One more copy 9f the packing Slip wrapped in polythylene bag to be kept inside the box at the prominent place.
- 9) **INDICATION MARKS ON THE BOXES:** Markings shall be provided on the boxes indicating position of Boxes for handling, storage and nature of consignment. For guidelines referred page 4 of 5. The ink issued for this purpose as well as for marking dispatch instruction shall be indelible/non-washable marking ink.
- 10) Each item as mentioned in BOQ shall be packed & supplied as a set comprising of required numbers of associated fasteners & hardware etc

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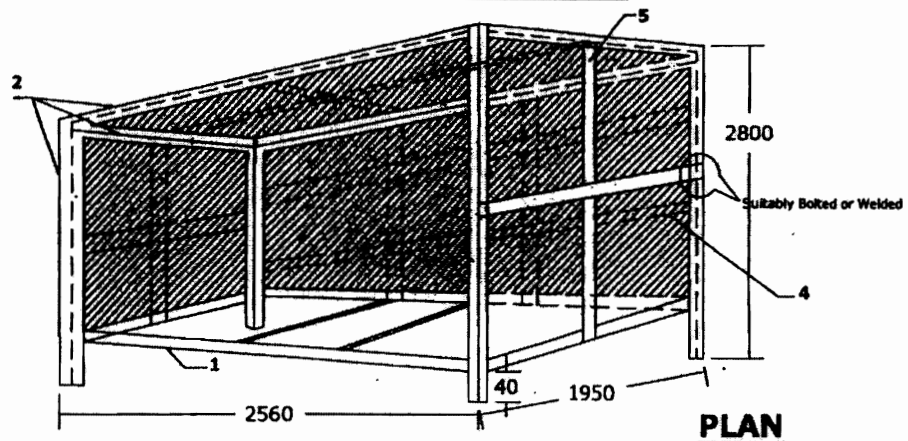
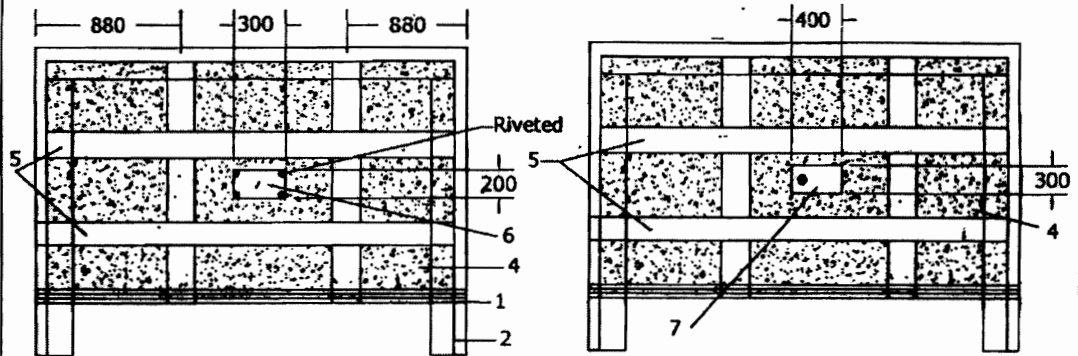
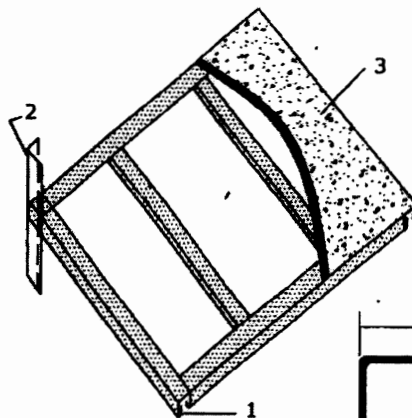
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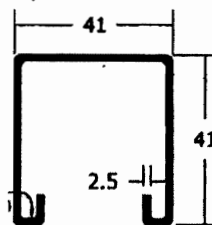
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**STEEL PACKING (TYPICAL DETAILS)****PLAN****FRONT SIDE OF BOX****BACK SIDE OF BOX****BOTTOM FRAME ARRANGEMENT****Note:**

1. "C" Channel to be used on Bottom Frame.
2. 50x50x6 Angle to be used Vertically on four sides of the Box and Horizontally on four sides on the top Frame.
3. 1.6mm thick sheet (plain) on Bottom Plate.
4. 1.0mm thick sheet to cover top & four sides of BOX.
5. 50x3 Flat as additional cross members to be used Horizontally & Vertically on top & Four Sides of Box.
6. Anodised Aluminium Plate for Marking.
7. Hinged Inspection Window.

**DETAILS OF "C" CHANNEL**



|                                                                                   |                                                                                                  |                                             |                 |
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### 11.3 PACKING FOR STATION LIGHTING SYSTEM

Aspects of packing specific to equipments / items of station lighting system are given here. All other instructions / aspects as per the main specification of export packing which are not covered here shall also be applicable.

#### 11.3.1 For LIGHTING TRANSFORMER, DISTRIBUTION BOARDS, LIGHTING PANELS,

- Construction of packing case for LIGHTING DISTRIBUTION BOARDS, LIGHTING PANELS, TRANSFORMER . shall be EITHER as per FIGURE 1,2,3,5,6,7,8,9,10,11 OR FIGURE 14,15,16.
- Each Panel/Transformer shall be individually covered with double polythene sheet of thickness 175 microns minimum.
- All the 6 inner surfaces of packing shall be nailed with bitumen coated hessian polythene craft paper. Wherever 2 pieces of craft paper are used, the joint shall have minimum overlap of 20mm.

For the top frame it shall be project on all sides by 100mm and shall be nailed on sides .

- The gap between the panels and packing case shall be filled with rubberized coir of thickness 50mm minimum and width 100mm. The distance between two consecutive supports of rubberized coir shall be less than 500mm.
- Silica get packed in cotton bags shall be placed at different positions inside the packing.
- Packing case shall be finally covered with GI sheet of thickness 0.4mm minimum.

#### 11.3.2 For LUMINARIES, RECEPTACLES. EMERGENCY LIGHT, 240/24V TRANSFORMER, CEILING FAN, SWITCH BOARDS, FLEXIBLE CONDUIT, WIRES, EARTH WIRE. JUNCTION BOXES, ERECTION COMMISSIONING SPARES, RECOMMENDED SPARES , ERECTION MATERIAL AND CONSUMABLES

- Construction of packing case for THE ABOVE MATERIAL shall be as per FIGURE 1to11.
- Items placed inside the case shall be covered with double polythene sheet of thickness 175 microns minimum.
- All the 6 inner surfaces of packing shall be nailed with bitumen coated hessian craft paper. wherever 2 pieces of craft paper are used, the joint shall have minimum overlap of 20mm. For the top frame it shall be project on all sides by 100mm and shall be nailed on sides.
- Silica get packed in cotton bags shall be placed at different positions inside the packing.

#### 11.3.3 For CONDUIT PIPE

As per international practice pipes are shipped in open bundles with metal strapping. Packing as per attached figure A shall be provided which is described as following:

- Each bundle shall be wrapped with 2 layers of 175 microns thick polythene sheet.
- Then bundle will be wrapped with bitumen coated hessian craft paper.
- Bundle shall be strapped with steel straps.
- An anodized aluminium packing description plate as per Figure No. 13 shall be provided.

#### 11.3.4 For POLES

Poles will be wrapped with 2 layers of minimum 175 microns thick polythene sheet and then with bitumen coated hessian craft paper, packed as per Figure – C i.e. bundling.

#### 11.3.5 For STRUCTURAL STEEL

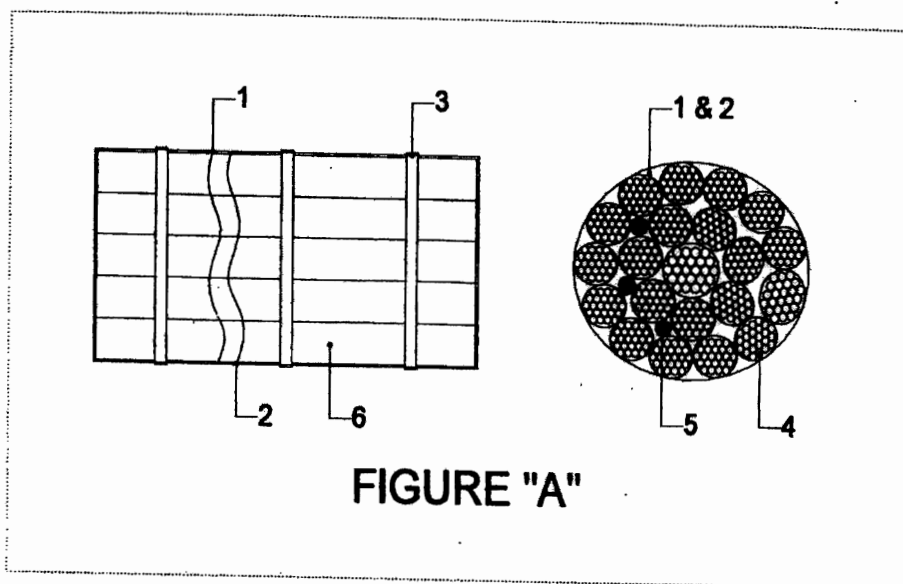
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Structural steel will be different sizes and shapes. Hence it will be packed as per Figure No. B and described as following :

- a) Each bundle shall be wrapped with 2 layers of 175 microns thick polythene sheet.
- b) Then bundle will be wrapped with bitumen coated hessian craft paper.
- c) Bundle shall be strapped with steel straps.
- d) An anodized aluminium packing description plate as per Figure No. 13 shall be provided.

|                                                                                   |                                                                                                  |                                      |                 |
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### **PACKING PROCEDURE FOR CONDUIT PIPE**



**FIGURE "A"**

- 1) LAYER OF BITUMEN COATED HESSIAN KRAFT PAPER.
- 2) LAYER OF POLYTHENE SHEET.
- 3) METAL STRAPPING.
- 4) CONDUIT PIPES.
- 5) SILICA GEL POUCHES.
- 6) BUNDLES OF CONDUIT PIPES.

**TITLE****TECHNICAL SPECIFICATION  
FOR SEAWORTHY PACKING  
FOR EXPORT JOBS**

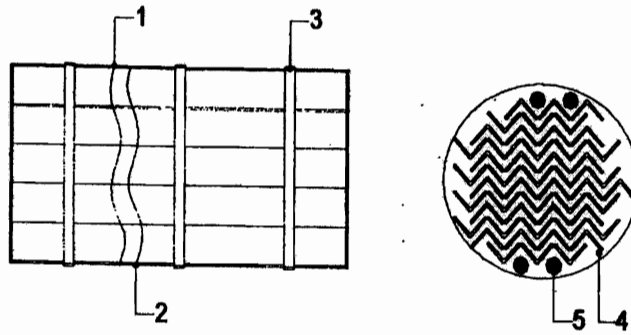
SPECIFICATION NO. PE-TS-888-100-A001

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SECTION D

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**PACKING PROCEDURE FOR STRUCTURAL STEEL****FIGURE "B"**

- 1) LAYER OF BITUMEN COATED HESSIAN KRAFT PAPER.
- 2) LAYER OF POLYTHENE SHEET.
- 3) METAL STRAPPING.
- 4) STRUCTURAL STEEL.
- 5) SILICA GEL POUCHES.



# TITLE

TECHNICAL SPECIFICATION  
FOR SEAWORTHY PACKING  
FOR EXPORT JOBS

SPECIFICATION NO. PE-TS-888-100-A001

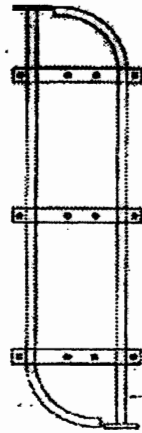
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SECTION D

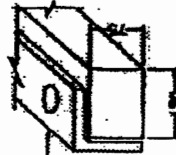
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## packing procedure for poles



POLES WRAPPED WITH POLYTHENE SHEET &  
EXTRUDING COATED HESSIAN CLOTH



TOP WOODEN BATTEN TO BE  
FIXED WITH L50x80x6 MM ON TOP  
OF IT FOR TIEING THE ROD  
25 MM DIA



BOTTOM WOODEN BATTEN TO BE  
FIXED ON L50x80x6 MM ANGLE

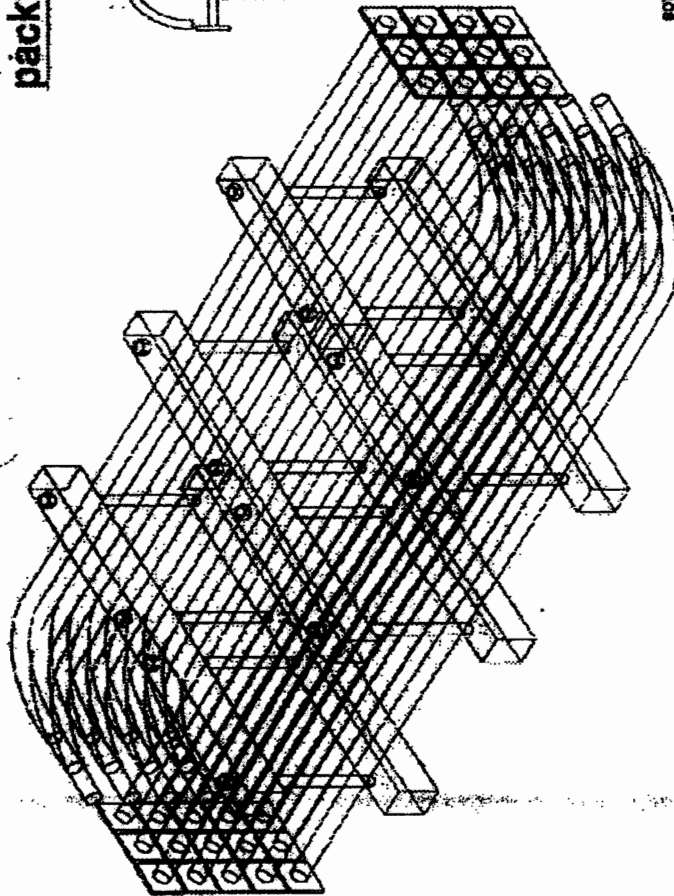


FIGURE "C"

|                                                                                   |                                                                                                  |                                             |                        |
|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|---------------------------------------------|------------------------|
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#### **11.4 PACKING FOR DC BATTERY**

The packing procedure for seaworthy packing of DC Battery is defined below, which is capable of withstanding impacts, compression, vibration, toppling, sea water spray, prevention against rust, temperature and extreme atmospheric conditions. Aspects of packing specific to equipments / items of DC Battery are given here. All other instructions / aspects as per the main specification of export packing which are not covered here shall also be applicable.

The packing procedure consists of various stages namely primary packing, cushioning, securing, desiccant, outside packing box, Runners/ sliders/ transverse bars of plywood, etc., provided for each movement.

- a) The packing boxes shall be made up of plywood boxes (thickness 9mm min.) with blocks at the bottom of the box for provision for handling the boxes using the forklift. The packing boxes sizes are generally standardized to half-euro size (capable of handling equipment's weight).
- b) Rubberized coir of 25mm thickness shall be provided as cushioning material at the bottom and thermocole of 20mm shall be provided inside on all four sides. Other than this polyethylene film wrap or cover also will be provided. Left out spaces to be filled with rubberized coir/ thermocol to get cushioning effect.
- c) Silica gel in dust free air permeable cotton/paper bag shall be placed in the packing boxes for storage period of 1 year as per IS 304 (1979)
- d) While packing the cells, transit caps (polypropylene) of red and blue shall be used for big size cells for ensuring that cells does not get damaged during the transport due to vibrations etc.
- e) The battery accessories shall be packed with suitable precautions as follows:
  - i) Copper connectors shall be packed after making bunches with lead wire seals to avoid misplacement.
  - ii) Hardware items shall be packed in polyethylene bags (Thickness  $\geq 0.175\text{mm}$ ) with item slip
  - iii) Battery rack shall be packed in dismantled condition, wrapped with polyethylene sheet
  - iv) For Ni-Cd type battery, electrolyte in solid form for dry cells shall be packed in cans with KOH, LiOH being packed separately.
  - f) Galvanized Steel straps are provided for binding the packing box sides.
  - g) The handling instructions shall be marked in indelible/ non-washable ink, indicating the upright position.

#### **11.5 PACKING OF SERVICE TRANSFORMERS(OIL FILLED) & ACCESSORIES**

This instruction is applicable for packing of transformers (oil filled), its accessories and components so as to ensure safe delivery to end user. Aspects of packing specific to equipments / items of transformers(oil filled) are given here. All other instructions / aspects as per the main specification of export packing which are not covered here shall also be applicable.

##### **11.5.01 PACKING DETAILS :**

- a) Items shall be packed in case / crates as per the shipping list.
- b) All fragile items and small items shall be packed in cases and to be marked as "Fragile, handle with care Fragile items".
- c) Fragile accessories are to be first packed in their original boxes (VENDOR's packing). Very

|                                                                                   |                                                                                                  |                                             |                 |
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- d small / delicate items such as glass thermometer, door keys shall be packed in separate box.
- d In case original box is found damaged, suitable alternate box or packing method using felt or foam sheet and polythene wrap to be used.
- e These boxes are then placed in identified wooden boxes. Inside of such boxes are lined with a layer of polythene sheet, packing wool / grass and another layer of polythene sheet before placing the boxes. All boxes are then wrapped with this polythene sheet before closing the box. Fragile items shall not be placed loose, one above the other inside the case.
- f All wiring cables, connection flats of non-ferrous materials, CTs, valves bellows shall also be packed.
- g Items like CTs, Oil communicating bushings, insulators, wired equipments and housings such as RTCC Panel, M. Box, Drive Mechanism, thermometers, gauges shall be wrapped in polythene from all around.
- h Buchholz relay and OSR relay openings will be blanked using covers, before putting them in the box
- i Items shall be carefully lowered and arranged inside the crate / case and each item shall be locked from all sides in such a way to avoid its movement in any way. Wooden stoppers and separators shall be provided for this and nailed to the crate / case wood.
- j Wooden planks and batons in contact with fragile items shall be provided with kit foam at the locations of contact.
- k Oil communication bushings shall be packed in separate case on V or U shape wooden felted supports, as in case of condenser bushings.
- l While placing and arranging the items inside the crates / cases, these shall be verified for correctness and then the packing note shall be signed. The cover top of the crate / case shall then be closed.
- m The main equipment like transformer tank shall be packed suitably to prevent any damage during transit / storage. Support structures like frame, header supports etc. shall be crated. Conservator headers shall also be crated. Radiators pipe work and other instruments & components shall be packed in cases. All the cases shall be lined with polythene from inside.

#### **11.6 ALTERNATIVE PACKING CASES FOR CONTROL PANELS AND SWITCH GEARS**

For Control and switch gear panels, construction of wooden packing cases may be provided as per fig 14 & 15 and as detailed below.

Thickness of planks for all sides, binding and jointing battens shall be at least 25 mm. Width of the plank shall be at least 125mm and that of binding and jointing planks shall be at least 100mm.

Top frame shall be suitable so that it does not collapse due to sandwiching between slings while lifting. Longitudinal and traverse bars for the bottom wooden pallet to be suitably selected.

Diagonal bracings shall be as per cl 9.3.1.3 and all other requirements shall be as per clauses 9.3.1.4 to 9.3.1.6.

#### **12.0 Containerization**

As required by BHEL, the VENDOR shall stuff the GOODS into 20 or 40 foot containers (dry, open top, flat racks, etc.).

The maximum inside dimensions of containers are to be considered:

|                                                                                   |                                                                                                  |                                      |                 |    |    |
|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|--------------------------------------|-----------------|----|----|
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- 40 foot containers: 11.80 m x 2.20 m x 2.05 m
- 20 foot containers: 5.80 m x 2.20 m x 2.05m
- 

The present definition of containerization is valid for sea containers only. Vendor to check the size of containers before start of packing of equipment.

#### 12.1 Protection of Cases/Crates

Since shipping containers are in general not water tight, packing in contact with the floor of the container shall be raised in order to prevent it from being damaged by the accumulation of water.

#### 12.2 Mechanical Constraints

The mechanical constraints for "general use" closed containers are of a different nature (height of "stacking" being limited inside the containers), the packing for the GOODS may be of a lighter structure. However, it is necessary that the packing be appropriate so as to protect the GOODS on site during the storage period, as required after discharging of the GOOD'S from the containers.

**Note:**

*It is the responsibility of the VENDOR to ensure that the cases/crates are stowed, secured and fastened inside the container. The VENDOR will take all necessary precautions to conform to the maximum weight allowed and the centre of gravity of the container. The securing and fastening of the cases/ crates can be carried out by nailing timbers on the bottom or on the vertical sides of the container.*

#### 13.0 Other Services to be provided by Vendor

In addition to the packing and shipping documents, VENDOR must also carry out the following services, which shall be included in his quotation:

Carriage of VENDOR's sub-contracted equipment and material, which must be re-grouped in VENDOR's or PACKER's workshops, whilst waiting for packaging.

BHEL reserves the right to postpone the shipping of the GOODS. In this event, any storage and insurance costs during the first ninety (90) days shall be borne by the VENDOR.

Loading, including lifting, securing, lashing, and stowing, of all cases, crates, or packages onto means of transportation such as, but not limited to, trailers, containers, etc.

#### 14.0 Responsibilities and Guarantees

VENDOR is responsible for the choice of category for packing according to the transport facilities used, and on the basis of the present document. In case of doubt or disagreement regarding the choice, VENDOR must inform BHEL prior to packing and await BHEL's approval. All phases of packaging, marking, loading, etc. will be subject to BHEL inspection.

BHEL reserves the right to reject the packing when the packing does not conform to these instructions and/or when the packing does not ensure perfect protection of the GOODS. VENDOR is responsible for the weights and dimensions declared, and the marking of the packages.

The documents must be in strict conformity with the packing contents.

The packing specified in these "Packing, Marking and Shipping Instructions" is guaranteed for a twelve (12) months storage period after delivery on site.

VENDOR is responsible for providing storage recommendation adapted to the GOODS. According to this guarantee, VENDOR is held responsible in the event of goods becoming



|                                                                                   |                                                                                                  |                                             |                 |
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useless, damaged or broken, as a result of poor packing and/or stowing, or due to corrosion, subsequent to insufficient or inadequate protection. All direct or indirect costs resulting thereof, will be back-charged to VENDOR.



**BHEL : BAP : RANIPET**  
**Water Business**  
**Annexure – III (Qualification Requirement)**

**QUALIFICATION REQUIREMENT for Reverse Osmosis (RO) System for Kilwa 1x371.2 MW**

Ref. RWT70516 Dtd.27.06.17

The Qualification requirements (QR) for participation in the tender for **RO System** is detailed below. Bidders should meet the qualification requirement as specified below. Offers of bidders who do not meet qualification requirement will not be considered.

**QUALIFICATION REQUIREMENT**

“Bidder should have supplied the RO system including membrane. RO system shall consist of RO pressure vessel, valves, piping (LP & HP), instruments, skid frame, supports & etc. as minimum.

Supplied RO system capacity shall not be less than 45 m<sup>3</sup>/hr. RO system equipment's like RO pressure vessel & RO membranes shall be sourced from such manufacturer who has supplied the RO pressure vessel & RO membrane to the RO system and such membrane should have been in successful operation for at least one (1) year prior as on technical bid opening date.

1.

| Sl. No. | Description            | Unit               | Values |
|---------|------------------------|--------------------|--------|
| a.      | RO system net capacity | M <sup>3</sup> /hr | 45     |

Documentary evidence to be submitted by the bidder (in support of meeting Qualification requirement)

1. Performance certificate from the end user for the successful operation of the reference plant for minimum one year as on on technical bid opening date
2. Purchase Order copy for the reference plant (unpriced)
3. Supporting documents clearly indicating capacity of each RO skid, & total RO plant capacity, type of RO membrane

**General**

2. Bidder shall furnish documentary evidence listed above in original (or) notarized legible copy as a proof of meeting the qualifying criteria for BHEL review. The certificate shall contain all required information for the satisfactory performance, such as plant capacity, location of the plant with postal address, date of supply & commissioning, design and actual performance parameters, etc. Acceptance of documentary evidence rests with BHEL.
3. Final acceptance of bidder is subject to the approval of BHEL's customer.



**BHEL : BAP : RANIPET**  
**Water Business**  
Annexure – III (Qualification Requirement)

**Qualification Datasheet**

**A. RO system Details: -**

**Date of Supply :**

**Date of commissioning:**

| Sl. No. | Parameters                   | Unit               | Design | Actual |
|---------|------------------------------|--------------------|--------|--------|
| 1.      | RO net output capacity       | m <sup>3</sup> /hr |        |        |
| 2.      | Feed water quality TDS       | ppm                |        |        |
| 3.      | RO permeate Quality          | ppm                |        |        |
| 4.      | Recovery                     | %                  |        |        |
| 5.      | Flux                         | lmh                |        |        |
| 6.      | Membrane type / manufacturer |                    |        |        |
| 7.      | End use                      |                    |        |        |

**B. Customer details: -**

- a. Name of the organisation :
- b. Designation :
- c. Mobile :
- d. Land line :
- e. Fax :
- f. Email id :
- g. Postal address :

**Signature of the Bidder with seal**

## Annexure-II

**MANDATORY SPARES for RO system (Ref. Matl. Code RWT 705160030 & Spec. ROS: 6169/R.00, ROS:6170/R.00 & ROS:4172)**

**I. PWTS RO Mandatory spares  
(A). Mechanical System**

| Sl. No | Spares Description            | Type of spare                    | Qty                                 | Unit |
|--------|-------------------------------|----------------------------------|-------------------------------------|------|
| 1      | Cartridge Filters             | Cartridge filter elements        | 10% of the total installed elements |      |
| 2      | RO High Pressure Pump Stage-1 | If vertical pump                 |                                     |      |
|        |                               | Shaft sleeves                    | 1                                   | set  |
|        |                               | Bearing                          | 1                                   | set  |
|        |                               | Wear rings                       | 1                                   | set  |
|        |                               | Impeller                         | 1                                   | set  |
|        |                               | Complete shaft                   | 1                                   | set  |
|        |                               | Shaft sleeve                     | 1                                   | set  |
|        |                               | Packing                          | 1                                   | set  |
|        |                               | Mechanical seal                  | 1                                   | set  |
|        |                               | Seals                            | 1                                   | set  |
|        |                               | Fasteners                        | 1                                   | set  |
|        |                               | Couplings                        | 1                                   | set  |
|        |                               | Bushes                           | 1                                   | set  |
|        |                               | All gaskets                      | 1                                   | set  |
|        |                               | “O” rings                        | 1                                   | set  |
|        |                               | Impeller nut                     | 1                                   | set  |
|        |                               |                                  |                                     |      |
|        | RO High Pressure Pump Stage-I | If horizontal pump               |                                     |      |
|        |                               | Shaft sleeves                    | 2                                   | set  |
|        |                               | Casing wear ring                 | 2                                   | set  |
|        |                               | Pump bearing                     | 2                                   | set  |
|        |                               | Fasteners                        | 1                                   | set  |
|        |                               | Complete coupling (pump & motor) | 1                                   | set  |
|        |                               | Mechanical seal                  | 1                                   | set  |
|        |                               |                                  |                                     |      |

|   |                                  |                                  |                                 |     |
|---|----------------------------------|----------------------------------|---------------------------------|-----|
|   |                                  |                                  |                                 |     |
| 3 | RO High Pressure Pump Stage - II | <b>If vertical pump</b>          |                                 |     |
|   |                                  | Shaft sleeves                    | 1                               | set |
|   |                                  | Bearing                          | 1                               | set |
|   |                                  | Wear rings                       | 1                               | set |
|   |                                  | Impeller                         | 1                               | set |
|   |                                  | Complete shaft                   | 1                               | set |
|   |                                  | Shaft sleeve                     | 1                               | set |
|   |                                  | Packing                          | 1                               | set |
|   |                                  | Mechanical seal                  | 1                               | set |
|   |                                  | Seals                            | 1                               | set |
|   |                                  | Fasteners                        | 1                               | set |
|   |                                  | Couplings                        | 1                               | set |
|   |                                  | Bushes                           | 1                               | set |
|   |                                  | All gaskets                      | 1                               | set |
|   |                                  | "O" rings                        | 1                               | set |
|   |                                  | Impeller nut                     | 1                               | set |
|   |                                  |                                  |                                 |     |
|   | RO High Pressure Pump Stage -II  | <b>If horizontal pump</b>        |                                 |     |
|   |                                  | Shaft sleeves                    | 2                               | set |
|   |                                  | Casing wear ring                 | 2                               | set |
|   |                                  | Pump bearing                     | 2                               | set |
|   |                                  | Fasteners                        | 1                               | set |
|   |                                  | Complete coupling (pump & motor) | 1                               | set |
|   |                                  | Mechanical seal                  | 1                               | set |
| 4 | RO Membranes Stage – I (PWTS)    | RO membrane                      | 10% of total installed membrane |     |
| 5 | RO pressure vessel               | Rupture disc /End plate assy.    | 20                              | Nos |
| 6 | RO Membranes Stage – II (PWTS)   | RO membrane                      | 10% of total installed quantity |     |
|   |                                  |                                  |                                 |     |
| 7 | RO CIP Pump                      | Shaft sleeves                    | 2                               | set |
|   |                                  | Casing wear ring                 | 2                               | set |

|    |                               |                                                       |   |     |
|----|-------------------------------|-------------------------------------------------------|---|-----|
|    |                               | Pump bearing                                          | 2 | set |
|    |                               | Fasteners                                             | 1 | set |
|    |                               | Complete coupling (pump & motor)                      | 1 | set |
|    |                               | Mechanical seal                                       | 1 | set |
|    |                               |                                                       |   |     |
| 8  | Complete Globe valve          | 10% of population of each type & size with min. 1 no. |   |     |
|    | Disc (Globe valve)            | 10% of population of each type & size with min. 1 no. |   |     |
|    | Stem (Globe valve)            | 10% of population of each type & size with min. 1 no. |   |     |
|    | Seal ring                     | 10% of population of each type & size with min. 1 no. |   |     |
|    | Gasket                        | 10% of population of each type & size with min. 1 no. |   |     |
|    | Yoke bush                     | 10% of population of each type & size with min. 1 no. |   |     |
| 9  | Butterfly valve               | 10% of population of each type & size with min. 1 no. |   |     |
|    | Reduction gear operator (BFV) | 10% of population of each type & size with min. 1 no. |   |     |
|    | Disc (BFV valve)              | 10% of population of each type & size with min. 1 no. |   |     |
|    | Stem (BFV)                    | 10% of population of each type & size with min. 1 no. |   |     |
|    | Seal ring                     | 10% of population of each type & size with min. 1 no. |   |     |
|    | Bearing (BFV)                 | 10% of population of each type & size with min. 1 no. |   |     |
|    | Gasket                        | 10% of population of each type & size with min. 1 no. |   |     |
| 10 | Check valve                   | 10% of population of each type & size with min. 1 no. |   |     |
|    | Flap/Door with pin (NRV)      | 10% of population of each type & size with min. 1 no. |   |     |
|    | Flap rings (NRV)              | 10% of population of each type & size with min. 1 no. |   |     |

(b). Electrical

| Sl. No | Spares Description                    | Unit | Quantity/set |
|--------|---------------------------------------|------|--------------|
| a)     | Motor for RO stage-1 HP pump (PWTS)   | No   | 01           |
| b)     | Bearing for RO stage-1 HP pump (PWTS) | Set  | 01           |
| c)     | Motor for RO stage-2 HP pump (PWTS)   | No   | 01           |
| d)     | Bearing for RO stage-2 HP pump (PWTS) | Set  | 01           |
| e)     | Motor for RO CIP pump                 | No   | 01           |
| f)     | Bearing for RO CIP motor              | Set  | 01           |

(c). E C&I

| S. No | Item Description                                    | Quantity / Unit                                                                         |
|-------|-----------------------------------------------------|-----------------------------------------------------------------------------------------|
| 1     | <b>CONTROL &amp; INSTRUMENTATION</b>                |                                                                                         |
| 1.1   | Local gauges (pressure, temperature, level, flow)   | 10% for each type and range subject to minimum 2 nos.                                   |
| 1.11  | Solenoid valve                                      | 10% for each type and size subject to minimum 2 nos.                                    |
| 1.12  | Flow meters                                         | Accessories (as recommended by the manufacturer) - minimum 2 nos in each type and size. |
| 1.13  | Transmitters (Pressure, temperature, Flow, level)   | 10% for each type and range subject to minimum 2 nos.                                   |
| 1.14  | Field switches                                      | 10% for each type and range subject to minimum 2 nos.                                   |
| 1.15  | Temperature elements and thermo wells               | 10% for each type, range and pipe size subject to minimum 2 nos.                        |
| 1.16  | SMART positioner                                    | Accessories as per manufacturer recommendation.                                         |
| 1.17  | Air filter regulator                                | 10% for each type and range subject to minimum 2 nos.                                   |
| 1.18  | Limit switches/Torque switches                      | 10% for each type and range subject to minimum 2 nos.                                   |
| 1.19  | Gaskets/Washers / O-Rings (for each size and type)  | 10% for each type and range subject to minimum 2 nos.                                   |
| 1.2   | Conductivity probes                                 | 10% for each type and range subject to minimum 2 nos.                                   |
| 1.21  | Indicators and Electrical metering instruments      | 10% for each type and range subject to minimum 2 nos.                                   |
| 1.22  | Junction boxes (Terminal blocks, cable glands, lug) | 10% for each type and range subject to minimum 2 nos.                                   |
| 1.23  | Terminal blocks, fuses, MCB's for VFD panel         | 10% for each type and size subject to minimum 2 nos.                                    |

## II. ETP RO Mandatory spares

### (a). Mechanical

| Sl. No | Spares Description       | Type of spare                                         | Qty                                 | Unit |
|--------|--------------------------|-------------------------------------------------------|-------------------------------------|------|
| 1      | Cartridge Filters        | Cartridge filter elements                             | 10% of the total installed elements |      |
| 2      | RO High Pressure Pump    | If vertical pump                                      |                                     |      |
|        |                          | Shaft sleeves                                         | 1                                   | set  |
|        |                          | Bearing                                               | 1                                   | set  |
|        |                          | Wear rings                                            | 1                                   | set  |
|        |                          | Impeller                                              | 1                                   | set  |
|        |                          | Complete shaft                                        | 1                                   | set  |
|        |                          | Shaft sleeve                                          | 1                                   | set  |
|        |                          | Packing                                               | 1                                   | set  |
|        |                          | Mechanical seal                                       | 1                                   | set  |
|        |                          | Seals                                                 | 1                                   | set  |
|        |                          | Fasteners                                             | 1                                   | set  |
|        |                          | Couplings                                             | 1                                   | set  |
|        |                          | Bushes                                                | 1                                   | set  |
|        |                          | All gaskets                                           | 1                                   | set  |
|        |                          | “O” rings                                             | 1                                   | set  |
|        |                          | Impeller nut                                          | 1                                   | set  |
|        | RO High Pressure Pump    | If horizontal pump                                    |                                     |      |
|        |                          | Shaft sleeves                                         | 2                                   | set  |
|        |                          | Casing wear ring                                      | 2                                   | set  |
|        |                          | Pump bearing                                          | 2                                   | set  |
|        |                          | Fasteners                                             | 1                                   | set  |
|        |                          | Complete coupling (pump & motor)                      | 1                                   | set  |
|        |                          | Mechanical seal                                       | 1                                   | set  |
| 3      | RO Membranes for RO skid | RO membrane (low fouling)                             | 10% of total installed membrane     |      |
| 4      | RO pressure vessel       | Rupture disc /End plate assy.                         | 20                                  | Nos  |
| 5      | Complete Globe valve     | 10% of population of each type & size with min. 1 no. |                                     |      |
|        | Disc (Globe valve)       | 10% of population of each type & size with min. 1 no. |                                     |      |



|   |                               |                                                        |
|---|-------------------------------|--------------------------------------------------------|
|   | Stem (Globe valve)            | 10% of population of each type & size with min. 1 no.  |
|   | Seal ring                     | 10% of population of each type & size with min. 1 no.  |
|   | Gasket                        | 10% of population of each type & size with min. 1 no.  |
|   | Yoke bush                     | 10% of population of each type & size with min. 1 no.  |
| 6 | Butterfly valve               | 10% of population of each type & size with min. 1 no.  |
|   | Reduction gear operator (BFV) | 10% of population of each type & size with min. 1 no.  |
|   | Disc (BFV valve)              | 10% of population of each type & size with min. 1 no.  |
|   | Stem (BFV)                    | 10% of population of each type & size with min. 1 no.  |
|   | Seal ring                     | 10% of population of each type & size with min. 1 no.  |
|   | Bearing (BFV)                 | 10% of population of each type & size with min. 1 no.  |
|   | Gasket                        | 10% of population of each type & size with min. 1 no.  |
| 7 | Check valve                   | 10% of population of each type & size with min. 1 no.. |
|   | Flap/Door with pin (NRV)      | 10% of population of each type & size with min. 1 no.  |
|   | Flap rings (NRV)              | 10% of population of each type & size with min. 1 no.  |

(b). Electrical

| Sl. No | Spares Description             | Unit | Quantity/set |
|--------|--------------------------------|------|--------------|
| a)     | Motor for RO HP pump           | No   | 01           |
| b)     | Bearing for RO stage-1 HP pump | Set  | 01           |

(c). Instruments

| S. No | Item Description                                  | Quantity / Unit                                                                         |
|-------|---------------------------------------------------|-----------------------------------------------------------------------------------------|
| 1     | <b>CONTROL &amp; INSTRUMENTATION</b>              |                                                                                         |
| 1.1   | Local gauges (pressure, temperature, level, flow) | 10% for each type and range subject to minimum 2 nos.                                   |
| 1.11  | Solenoid valve                                    | 10% for each type and size subject to minimum 2 nos.                                    |
| 1.12  | Flow meters                                       | Accessories (as recommended by the manufacturer) - minimum 2 nos in each type and size. |

|      |                                                     |                                                                  |
|------|-----------------------------------------------------|------------------------------------------------------------------|
| 1.13 | Transmitters (Pressure, temperature, Flow, level)   | 10% for each type and range subject to minimum 2 nos.            |
| 1.14 | Field switches                                      | 10% for each type and range subject to minimum 2 nos.            |
| 1.15 | Temperature elements and thermo wells               | 10% for each type, range and pipe size subject to minimum 2 nos. |
| 1.16 | SMART positioner                                    | Accessories as per manufacturer recommendation.                  |
| 1.17 | Air filter regulator                                | 10% for each type and range subject to minimum 2 nos.            |
| 1.18 | Limit switches/Torque switches                      | 10% for each type and range subject to minimum 2 nos.            |
| 1.19 | Gaskets/Washers / O-Rings (for each size and type)  | 10% for each type and range subject to minimum 2 nos.            |
| 1.2  | Conductivity probes                                 | 10% for each type and range subject to minimum 2 nos.            |
| 1.21 | Indicators and Electrical metering instruments      | 10% for each type and range subject to minimum 2 nos.            |
| 1.22 | Junction boxes (Terminal blocks, cable glands, lug) | 10% for each type and range subject to minimum 2 nos.            |
| 1.23 | Terminal blocks, fuses, MCB's for VFD panel         | 10% for each type and size subject to minimum 2 nos.             |